2003 Summary Report
Missouri Nutrition Surveillance System

Pregnancy Nutrition Surveillance

Missouri Department of Health and Senior Services

Preface

This report summarizes selected key maternal health indicators of women, participating in the Missouri WIC in 2003, which contributed to the Missouri Pregnancy Surveillance System in 2003.

Missouri Department of Health and Senior Services

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Nutrition related factors that affect maternal and infant health include maternal prepregnancy weight, weight gain during pregnancy, iron deficiency anemia, and infant-feeding method. Behavioral factors such as tobacco use and time of entry into prenatal care can influence birth outcome and the mother's health as well.

The Centers for Disease Control and Prevention (CDC) Pregnancy Nutrition Surveillance System (PNSS) has monitored nutritional and behavioral risk factors among low-income, pregnant women enrolled in public health programs in participating states since 1979. In 2003, Missouri PNSS used data from only Special Supplemental Nutrition Program for Women, Infants and Children (WIC). The data included complete, prenatal and postpartum records with demographics, health and behavior, and infant birth outcomes information.

In 2003, the biggest proportion of PNSS population in Missouri was White/Non-Hispanic women. The Hispanic portion of the population has been increasing from 1994 to 2003. Women aged 20-29 years made up a large proportion of Missouri PNSS population in 2003. The prevalence of young mothers (17 years and younger) has been decreasing over the last 10 years. Most of the Missouri PNSS participants in 2003 had high school or higher education. Two thirds of PNSS participants were at income level 0-100% of the federal poverty level. Almost all of the participants reported not being migrants.

A large proportion of 2003 Missouri PNSS participants reported being overweight or obese during the prepregnancy period. Black/Non-Hispanic women and those 40 years and older were at higher risk to have this factor. In contrast, Asian/Pacific Islander women, as well as those 15-17 years old, were most likely to be underweight before the pregnancy.

Adequate weight gain during pregnancy is crucial to the successful intrauterine growth and development of the fetus. Even with improved access to nutritious foods and nutrition education, the majority of women participating in 2003 Missouri PNSS and National PNSS showed inadequate (greater than ideal or less than ideal) gestational weight gain. The Asian/Pacific Islander women were more likely to gain less than ideal weight, while American Indian/Alaskan Native and White/Non-Hispanic women reported gaining greater than ideal weight during pregnancy. Only a third of Missouri PNSS participants aged 15-19 years gained adequate gestational weight. Unfortunately, in Missouri 2003 PNSS data, it was not possible to state when the women enrolled in WIC to show the effect of timing WIC participation on maternal weight gain.

Iron deficiency anemia in pregnancy develops if a woman does not have enough iron to fuel hemoglobin production for herself and her baby. A major cause of iron deficiency anemia during pregnancy is poor iron in diet, vitamin deficiency, and smoking. This disorder during pregnancy may be prevented. During the last 10 years, the rate of iron deficiency anemia (low hemoglobin/Hematocrit) in the third trimester of pregnancy and postpartum among PNSS participants in Missouri has shown no progress. In 2003, the prevalence of low hemoglobin/Hematocrit was higher among Missouri PNSS participants than reported at the national level. Black/Non-Hispanic women and 15-17 years old participants were more likely to have low hemoglobin/Hematocrit during the 3rd trimester of pregnancy and postpartum. White/Non-Hispanic women had the smallest proportion of low hemoglobin/ Hematocrit.

Prenatal care is very important in poor birth outcome prevention. In 1994-2003, the majority of women in Missouri PNSS received medical care during the first trimester of pregnancy. This proportion in 2003 (almost three fourths of all participants) was still lower than in the national PNSS population. Also, the percentage of pregnant women participating in the 2003 PNSS, who received no medical care, was higher in Missouri compared to all the other states contributing to PNSS. The largest proportion of Missouri PNSS women were enrolled in WIC during the first trimester of pregnancy in 2003, rather than the second and third trimester and post partum. The percentage of enrollment during the first trimester in Missouri was higher than the national average.

Women who smoke during pregnancy often have smaller babies compared to women who do not smoke. In 1994-2003, more than one third of WIC women smoked three months prior to pregnancy and about one fourth of WIC pregnant women smoked in the last three months of pregnancy. Race/ethnicity and educational level had strong impacts on WIC women's smoking behavior. White women in WIC had the highest rate of smoking and the women of Asian/Pacific Islander origin had the lowest rate. The smoking rates of WIC women who smoked 3 months prior to pregnancy and the last 3 months of pregnancy were the highest among those who received less than 12 years of education.

Risk factors for preterm delivery, according to Missouri 2003 PNSS data, include being underweight before pregnancy, lower than ideal weight gain during the pregnancy, and mothers aged 15 years and younger or 40 years and older. Black/Non-Hispanic women were more likely to have a preterm baby compared to all other race/ethnic groups.

In the 2003 Missouri PNSS population, women who were underweight before pregnancy and those who gained less than ideal gestational weight were more likely to deliver a low birthweight baby. Older women (40 years and older) and Black/Non-Hispanic PNSS participants had the highest percentage of low birthweight infants. In the 2003 Missouri PNSS, women, who were obese before pregnancy, and women with greater than ideal maternal weight gain were more likely to have a high birthweight baby. In addition, American Indian/Alaskan Native and women aged at 30-39 years were at higher risk of having a high birthweight infant. The 10-year trend in high birthweight demonstrates a slight decline of the percentage of babies born overweight.

The proportion of women ever breastfed during the last 3 years has not changed. Over two thirds of Hispanic PNSS participants in Missouri, two third of women with greater than high school education, and more than one half of the women aged 30-39 years were more likely to initiate breastfeeding in 2003.

INTRODUCTION

The Pregnancy Nutrition Surveillance System (PNSS) is a program-based public health surveillance system that monitors risk factors associated with infant mortality and poor birth outcomes among low-income pregnant women who participate in federally funded public health programs.

In 2003, Missouri PNSS used data from Special Supplemental Nutrition Program for Women, Infants and Children (WIC). The number of records accepted for the Missouri PNSS in 2003 was 44,884, which is 2.7% higher than in 2002 (43,699). Records analyzed by the Centers for Disease Control and Prevention (CDC) consisted of 8.4% of prenatal records, 21.3 % of postpartum records, and 70.3% of compete prenatal and postpartum records. Data was contributed by 196 WIC clinics, which collected data on demographic and health and behavioral indicators during prenatal and postpartum clinic visits.

Demographic data collected included maternal race/ethnicity, age, educational level, poverty level and migrant status. Participation in food and medical assistance programs (e.g., Food Stamp Program or Medicaid) was collected as well.

The other data included maternal health and behavioral risk factors and infant health indicators. Maternal health indicators in Missouri PNSS consisted of prepregnancy weight status, maternal weight gain, and iron deficiency anemia (low hemoglobin or Hematocrit). The behavioral risk factors assessed were medical care, WIC enrollment, and smoking. Infant health indicator data included birthweight, preterm births, full term low birthweight, and breastfeeding initiation.

The uniqueness of the 2003 report is that the CDC provided states participating in PNSS with a summary of trends in some indicators for time periods 1983-2003 and 1994-2003. Also, the CDC generated Combined 3-Year Tables for counties and clinics to provide analysis for a WIC clinic or county that served less than 100 women a year. For example, Atchison County had only 41 records included in the analysis in the 2003 PNSS report and CDC did not calculate percentages for the county because less than 100 records were available for analysis after exclusions. However, in the 2001-2003 Combined Table, Atchison County has 132 records studied by CDC; therefore, the tables contain 3-year average rates for Race/Ethnic Distribution, Maternal Health Indicators, Maternal Behavioral Indicators, Maternal Smoking Indicators, and Infant Health Indicators. This allowed the ability to create maps with the combined 3-year data by county to show the rates in the most important indicators (Appendix 1).

Limitations of the Pregnancy Nutrition Surveillance System

In Missouri, only the WIC program contributed to the PNSS, so the Missouri PNSS population could not represent all low-income women in the state (applicants must meet specific income guidelines and must be at nutritional risk to participate in WIC.) Since not all states in the country participate in the PNSS, the "national" data do not reflect all such women in the United States, at least in part due to large demographic and other differences between states.

Other limitations relate to continuity of service and information tracking and reporting. Some women who were served by WIC in Missouri during the pregnancy could not be served postpartum because of enrollment policies. Some women moved into or out of a service area while pregnant. Also, since women came to clinics at different times during and after their

pregnancies, information was not always available for the complete pregnancy record of all women. Another complication was that CDC did not analyze data for any clinic or county reporting less than 100 records.

Nevertheless, PNSS is a unique data set in that it is the largest, most diverse (racially, ethnically, and geographically) data set available on low-income pregnant women in the nation [1]. The contribution of only WIC data to the PNSS in Missouri allows easier application of the conclusions and recommendations to WIC-participating women. Thus, it helps determine risk factors and to enhance planning interventions to decrease infant mortality and poor birth outcomes among the state's low-income populations at nutritional risk.

MATERNAL DEMOGRAPHIC CHARACTERISTICS

Race/Ethnicity

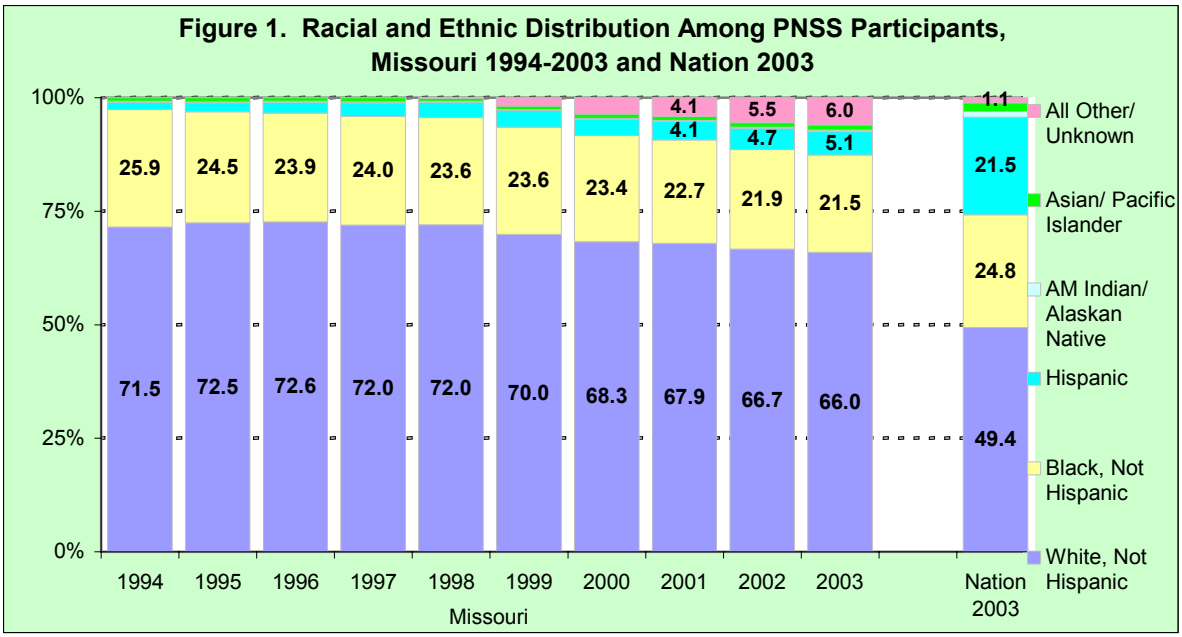
Race/Ethnicity data were analyzed because differences that are observed in racial and ethnic groups may reflect differences in their susceptibility or exposure to disease or a health problem, or the persistence of that disease or problem.

The Missouri 2003 PNSS population included 66.0% White/Non-Hispanic women, 21.5% Black/Non-Hispanic women, 5.1% Hispanic women, 0.4% American Indian/Alaskan Native women, 1.1% Asian/Pacific Islander women, and 6.0% from the All Other/Unknown category (Figure 1). Since 1994, the percentage of Hispanic women participating in PNSS has increased 3.2 times from 1.6% to 5.1%. The proportion of the All Other/Unknown category has been stable from 1994 to 1997 and equaled 0.0%, but since 1998, it has been increasing from 0.1% to 6.0% in 2003.

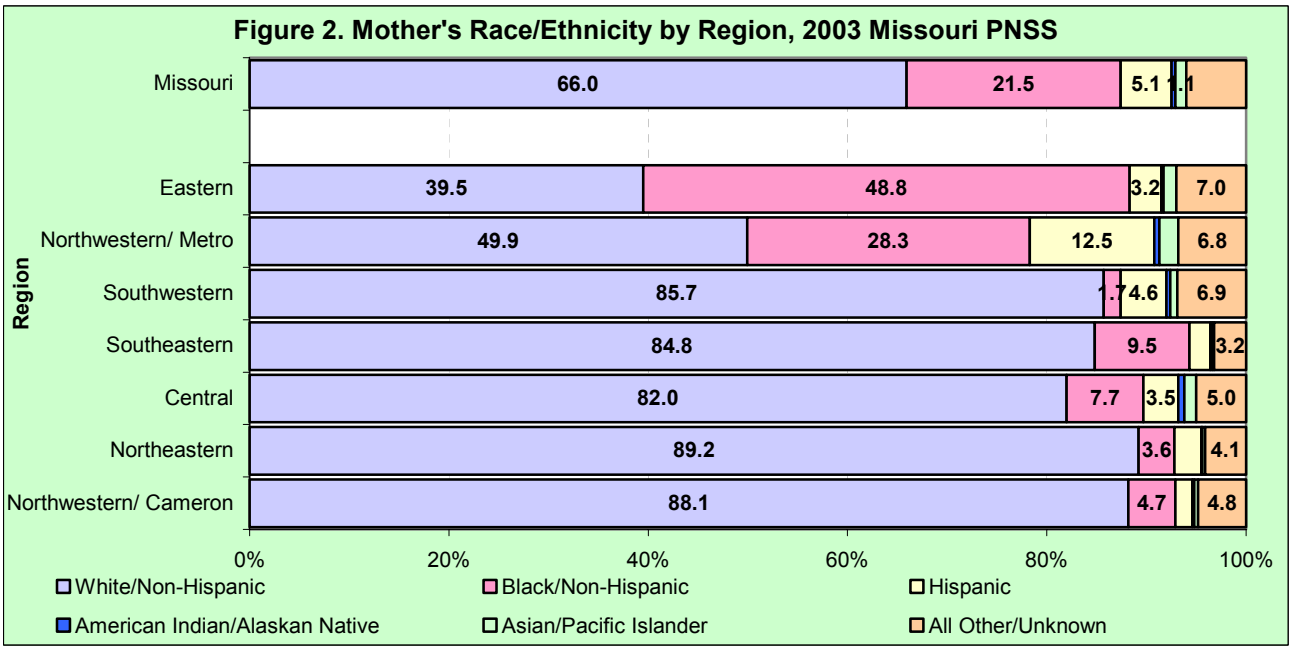
The national composition of women participating in the system in 2003 included 49.4% White/Non-Hispanic, 24.8% Black/Non-Hispanic, 21.5% Hispanic, 1.3% American Indian/Alaskan Native, 1.9% Asian/Pacific Islander, and 1.1% all other or unspecified race or ethnicity[1]. The major difference between the National PNSS and the Missouri PNSS is in the Other/Unknown category (in the 2003 Missouri PNSS, women were 6 times more likely to have 'Unknown' and 'All Other' categories of their race or ethnicity than in the 2003 National PNSS)[2].

[1] The proportion of White/Non-Hispanic PNSS women is significantly higher and the proportion of Hispanic women is much lower in the 2003 Missouri PNSS than in the general population of all US PNSS participants in 2003; therefore, in the report to make a Missouri PNSS population comparable to the Nation, a standardization of some indicators was used. As a result of the standardization, the adjusted prevalence for the Missouri PNSS is the prevalence if the racial and ethnic distribution in the state PNSS was identical to that of the national PNSS.

[2] One of the explanations for the high percentage of unknown/all other category in MO could occur when Medicaid or another Missouri special program for low-income women assigns a DCN (Departmental Client Number) and keys an unknown value in the Race/Ethnicity category. In this situation, the participant begins WIC with an unknown/all other race or ethnicity. As of April 11, 2005, no WIC participants should have any unknown values for race or ethnicity.

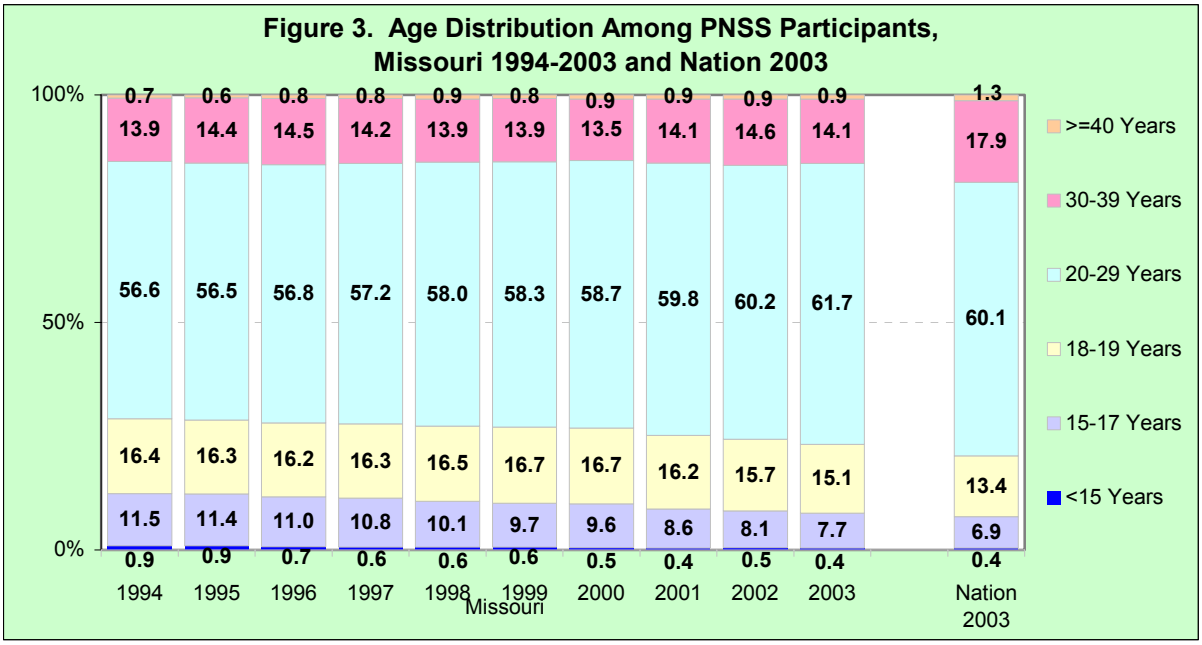


The demographic disparity between different WIC regions was so large that it was not possible to compare WIC regions. For example, in the Northeastern region, the proportion of White/Non-Hispanic women was 89.2%, while in the Eastern region, White/Non-Hispanic women consisted of less than 40% (Figure 2). The region with the largest percentage of Hispanic women was Northwestern (12.5%). Almost half of all PNSS participants in the Eastern region were Black/Non-Hispanic women, while in the Southwestern region there were only 1.7% Black/Non-Hispanic women participating in the 2003 PNSS.



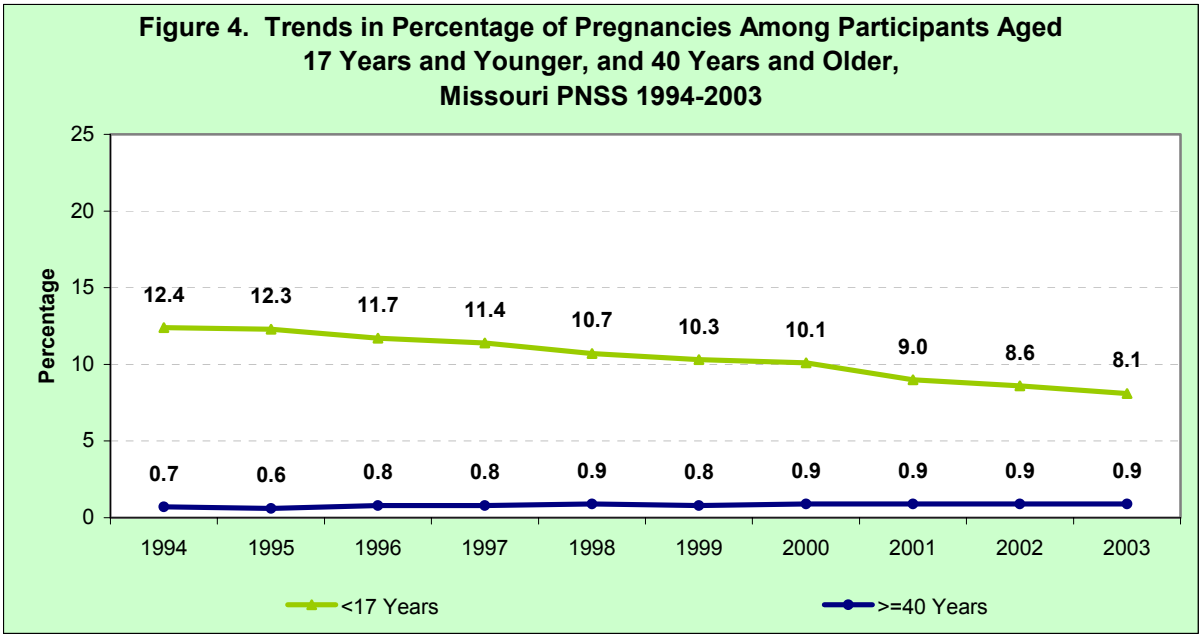
Age

Age might be considered as a risk factor because health indicators can vary by age. In the year 2003, 0.4% of women participating in the Missouri PNSS were younger than15 years, 7.7% were aged 15-17 years, 15.1% were aged 18-19, and 61.7% of women were between 20-29 years old (Figure 3). Women aged 30-39 years contained 14.1% of 2003 Missouri PNSS population, and the additional 0.9% were women 40 years and older. In 2003, the Missouri PNSS population was slightly younger on average than the National PNSS population in 2003 (84.9% of Missouri PNSS women were younger than 30 years, compared to 80.8% in the National PNSS data).



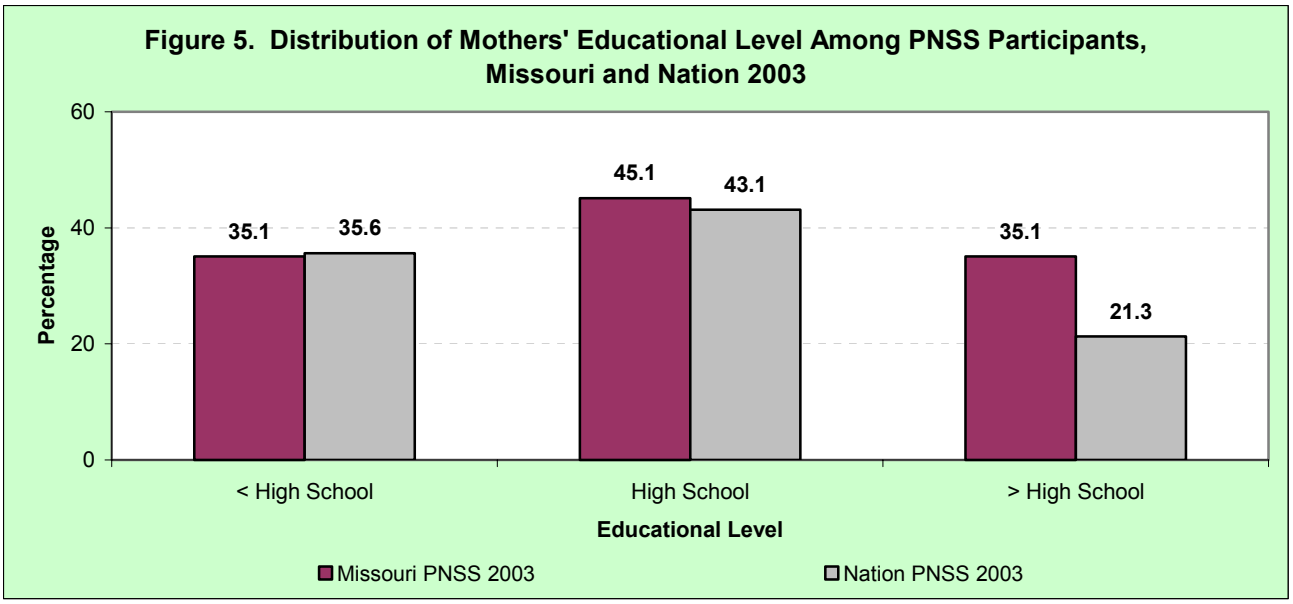
Teens (<15 years and 15–17 years) and older women (>40 and older 40 years of age) were the age groups at greatest risk of poor birth outcomes [2]. In the 2003 Missouri PNSS, about 8.1% of all mothers were teenagers aged 17 years and younger (0.4% were less than 15 years old, and 7.7% were aged 15-17 years). During the years 1994-2003, the proportion of teen mothers in Missouri PNSS has been constantly decreasing (Figure 4). In 2003, 0.9% of WIC participating women in Missouri were 40 years old or older. The proportion of this age group in the Missouri PNSS population has not changed significantly over the ten previous years.

Figure 4. Trends in Percentage of Pregnancies Among Participants Aged 17 Years and Younger, and 40 Years and Older, Missouri PNSS 1994-2003



Education

Educational level among PNSS participants can be used as an indirect measure for socioeconomic status. Also, educational level can be important in relation to behavioral indicators, such as smoking habits and breastfeeding initiation. Of the 2003 year participants in Missouri, 19.8% had completed a greater than high school education, 45.1% had completed high school, and 35.1% had not received a high school education (Figure 5). The percentage of women with high school and greater than a high school education participating in the Missouri PNSS in 2003 was similar to the average of all states contributing to the system in 2003.



Poverty Level/Migrant Status

The vast majority (65.9%) of PNSS participants in Missouri in 2003 reported household income between 0 and 100% of the federal poverty level, while 32.3% reported household income at 101-200% of the federal poverty level. Nationally, 65.7 % of all women participating in the 2003 PNSS were at household income levels below 100% of the federal poverty level, and 31.6% reported household income at 100-200% of the federal poverty level.

A small proportion of the Missouri PNSS participants reported that they were migrants in 2003 (0.1%). The average of migration among PNSS participants in all other states participating in the surveillance system in 2003 was 0.8%.

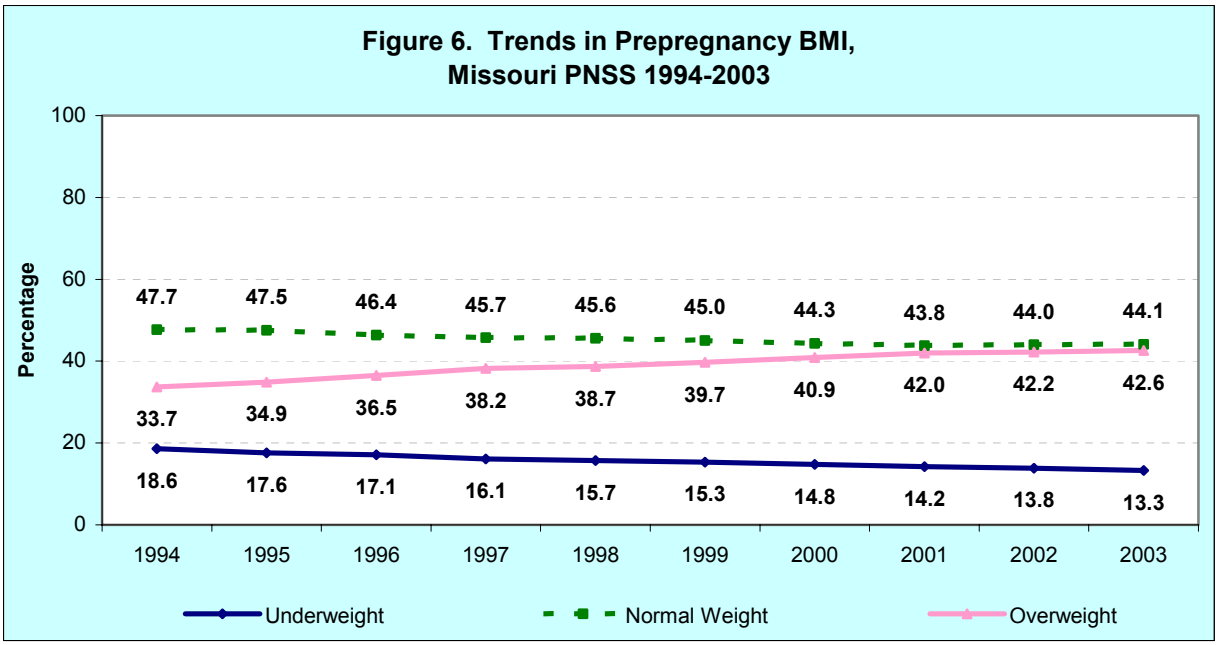
MATERNAL HEALTH AND BEHAVIORAL RISK FACTORS

Prepregnancy Weight Status[3]

Prepregnancy weight is an indicator of the nutritional status of a woman before she becomes pregnant [3] and is a major factor affecting birth weight and therefore, health of the newborn and the mother [4]. An association between prepregnancy weight and birth weight was documented as early as the 1950s and has been confirmed in more recent studies [5]. Prepregnancy underweight can be a determinant of low birthweight, preterm, and full term low birthweight, while prepregnancy overweight and obesity are associated with delivery of a high birthweight baby and cesarean section delivery. An association between prepregnancy weight and stillbirth has been reported, with the lowest risk among normal weight women and the highest risk among overweight women [6].

In the PNSS, prepregnancy weight status was determined by the body mass index (BMI[4]). In WIC clinics, self-reported prepregnancy weight and measured height are used to calculate prepregnancy BMI and then, according to the prepregnancy BMI, women are classified into one of four weight categories, specified by the Institute of Medicine [7]: underweight, normal weight, overweight, and obese.

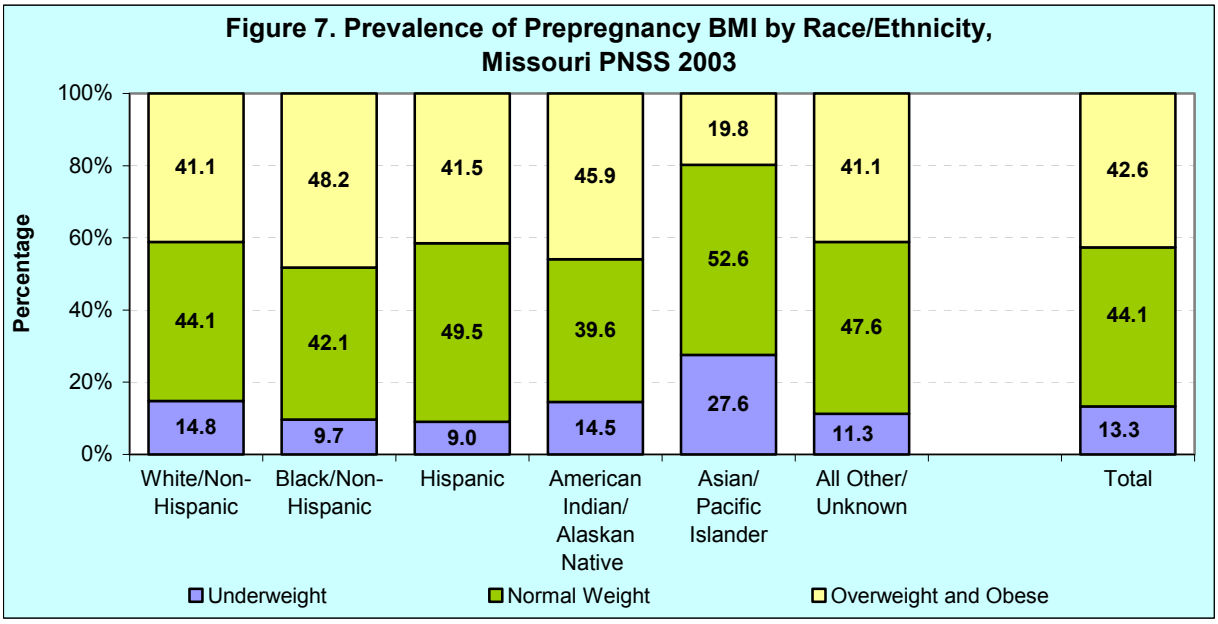
The percentage of women in the PNSS with low prepregnancy weight has been decreasing from 18.6% to 13.3% through the years 1994-2003, while the prevalence of prepregnancy overweight has been increasing from 33.7% in 1994 to 42.6% in 2003. The proportion of women with adequate BMI before pregnancy has been declining over the years (Figure 6).



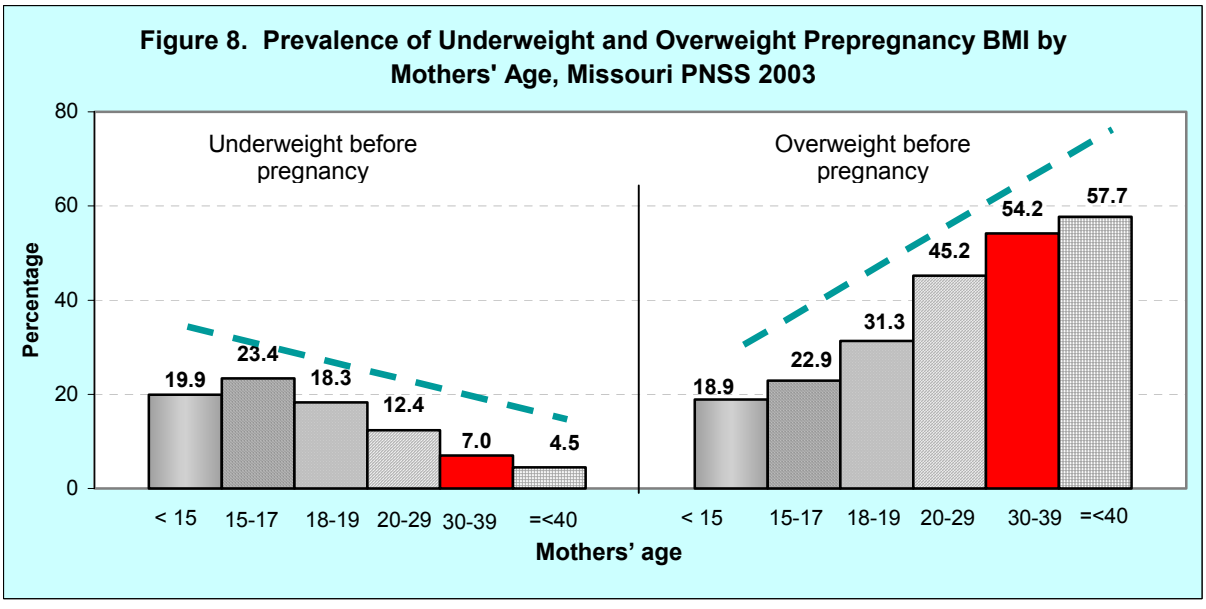
[3] Refer to the maps in Appendix 1 to see prevalence of prepregnancy underweight by county, and Appendix 2 for prevalence of prepregnancy overweight by county (Missouri PNSS 2001-2003 combined years)

[4] BMI uses a mathematical formula that takes into account both a person's height and weight. BMI equals a person's weight in kilograms divided by height in meters squared. (BMI=kg/m2)

In the 2003 Missouri PNSS, the highest percentage of underweight prior to pregnancy was among Asian/Pacific Islander women (27.6%) (Figure 7). Also, Asian/Pacific Islander women were more likely to have normal weight during the prepregnancy period (52.6%) compared to women of other racial and ethnic groups; while Black/Non-Hispanic PNSS participants in 2003 were more likely to be overweight before pregnancy (48.2%) and women in the American Indian/Alaskan Native group were less likely to have normal weight prior to pregnancy (39.6%).

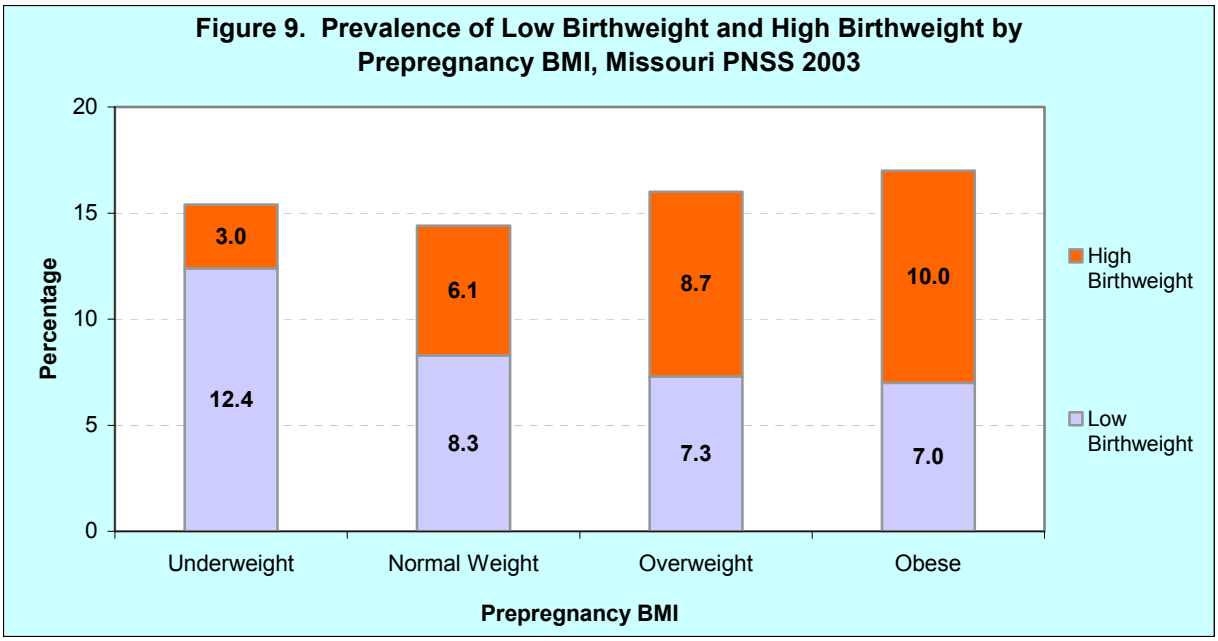


In the 2003 Missouri PNSS population, women aged 19 years and younger were more likely to be underweight before pregnancy (Figure 8). Prepregnancy overweight prevalence was over 50% among women 30 years and older. The 2003 Missouri PNSS prepregnancy overweight and underweight rates showed almost linear association between age and prepregnancy BMI.

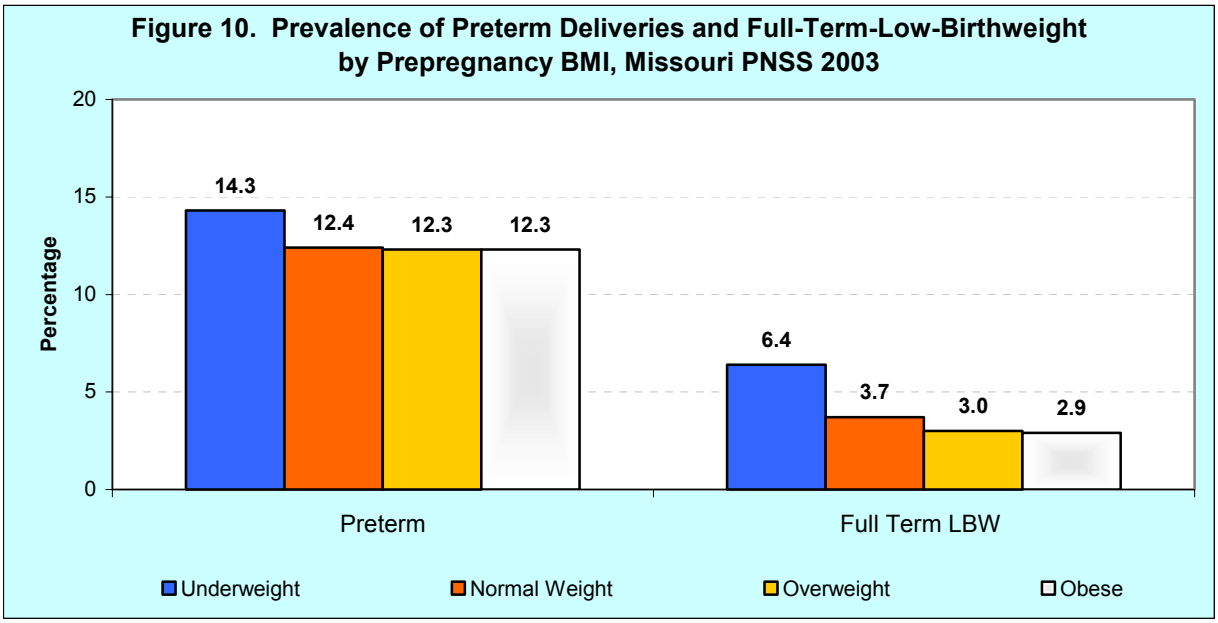


In the 2003 Missouri PNSS, women who were underweight before the pregnancy were more

likely to deliver a low birthweight baby (12.4%) compared to women who were normal weight or overweight (8.3% and 7.3%, respectively) (Figure 9). Women who were obese before pregnancy were over 3 times likely to have a high birthweight infant (10.0%) than those with an underweight prepregnancy BMI (3.0%).



The prevalence of delivering a preterm or full-term-low-birthweight (FTLB) baby was higher in women with a low prepregnancy BMI (14.3% of preterm deliveries and 6.4% of FTLB) than among women having normal weight (12.4 % of preterm deliveries and 3.7% FTLB) or being overweight (12.3% of preterm deliveries and 3.0% FTLB) prior to the pregnancy (Figure 10).

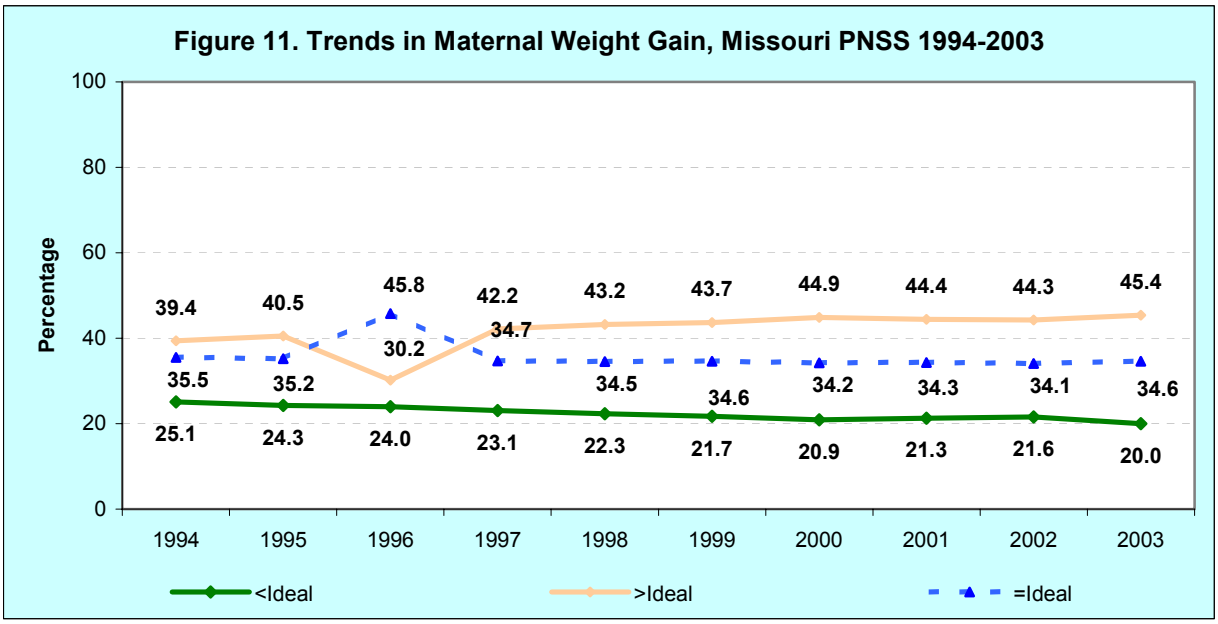


Maternal Weight Gain[5]

Maternal (gestational) weight gain refers to the amount of weight gained from conception to delivery. The Institute of Medicine (IOM) recommends higher weight gain for women with a low prepregnancy weight than for women with a high prepregnancy weight: 28-40 pounds (lbs) for underweight women, 25-35 lbs for normal weight women, 15-25 lbs for overweight women, and at least 15 lbs for very overweight (obese) women [8].

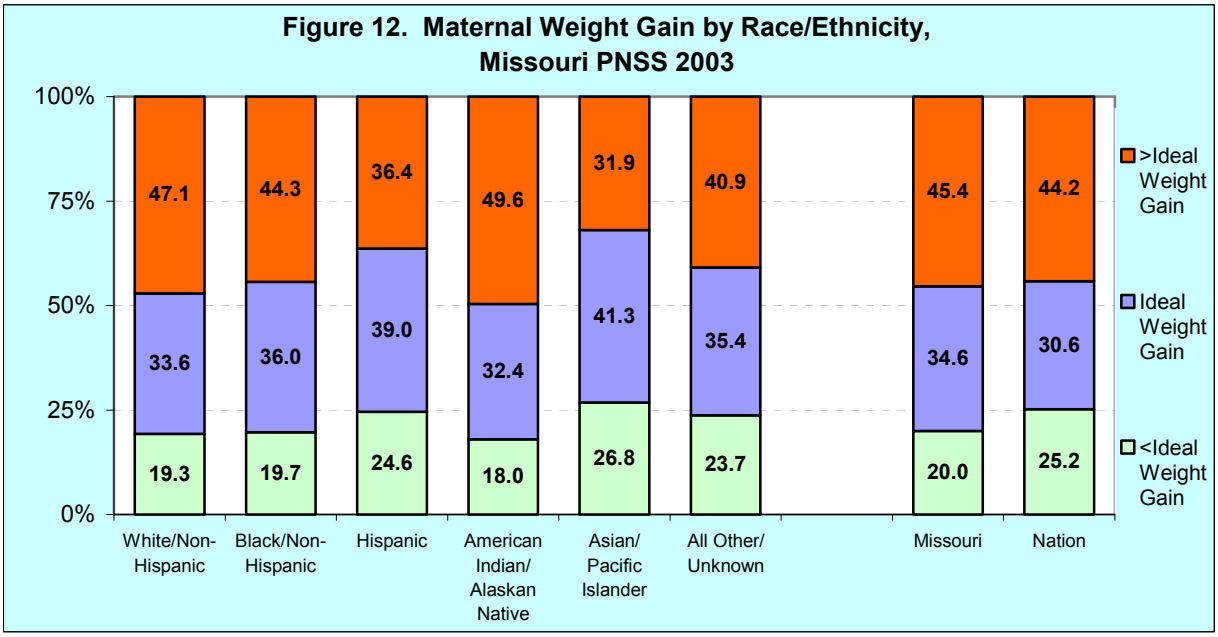
This indicator in full-term pregnancies is the most significant predictor of birth weight, as well as infant mortality and morbidity. Less than ideal weight gain is associated with lower than average fetal growth; while greater than ideal weight gain increases the risk of cesarean deliveries, spontaneous preterm delivery and is associated with neonatal complications [9]. Adequate maternal weight gain is affected by many factors. Such factors within the woman's control include the nutritional quality of food and smoking during pregnancy [10]. Also, other risk factors are genetics, age, ethnic background, and income [11]. All of these factors can be taken into consideration and used at WIC agencies.

In the Missouri PNSS, the percentage of less than ideal and greater than ideal weight gain during pregnancy has been changing from 1994 to 2003 (Figure 11). The lowest rate of greater than ideal gestational weight gain was reported in 1996[6] (30.2%); the highest was in 2003 (45.4%). However, the 2003 Missouri PNSS included the smallest prevalence of less than ideal maternal weight gain (20.0%) that was registered since 1994.

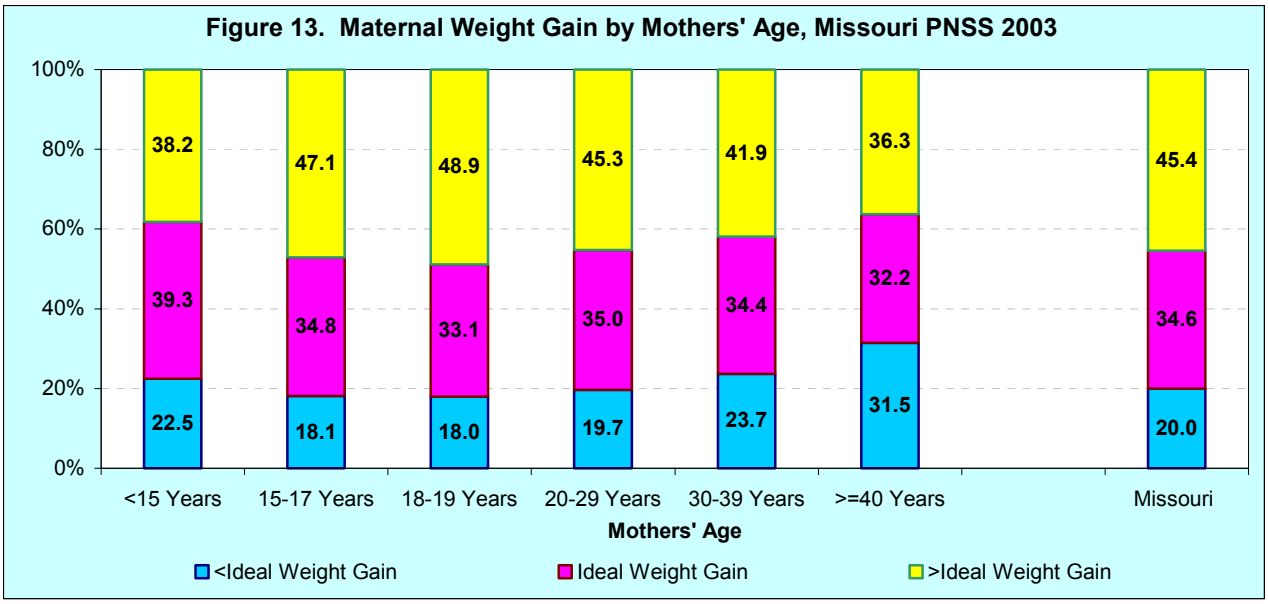


[5] Refer to the maps in Appendix 3 to see prevalence of less than ideal maternal weight gain by county, and Appendix 4 for prevalence of greater than ideal weight gain by county (Missouri PNSS 2001-2003 combined years)
[6] Our investigation revealed a chance that 1996 data on this indicator were not computed correctly.

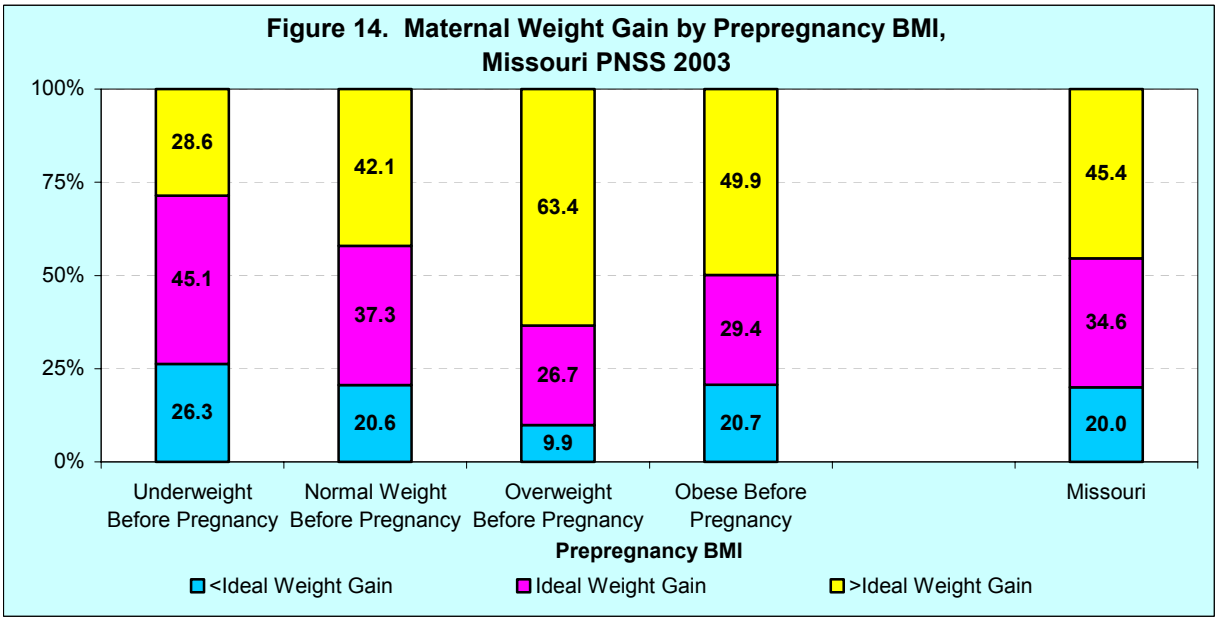
Even so, in 2003, the majority of women (65.4%) participating in the Missouri PNSS did not gain adequate weight during pregnancy (20.0% gained less than ideal and 45.4% greater than ideal). The prevalence of women with greater than ideal gestational weight gain was highest among American Indian/Native Alaskan women (49.6%) and lowest among Asian/Pacific Islander women (31.9%) (Figure 12). The prevalence of adequate weight gain during pregnancy among the 2003 Missouri PNSS population was lowest among American Indian/Native Alaskan women (32.4%) compared to all other race/ethnic groups, and highest among Asian/Pacific Islander participants (41.3%).



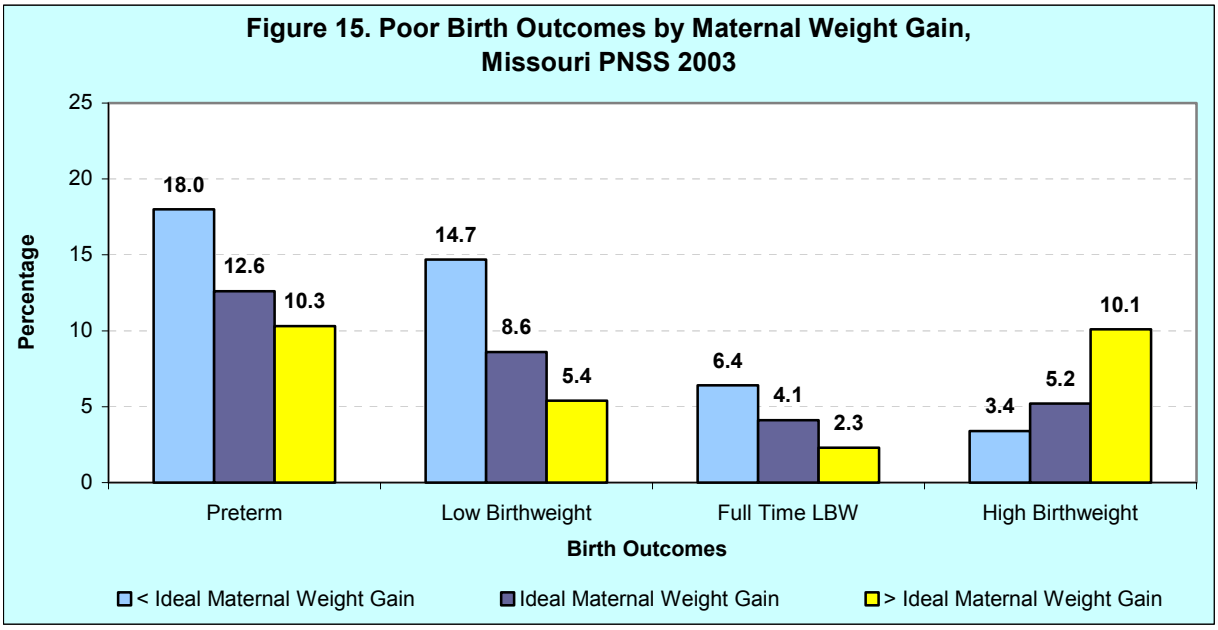
In the Missouri PNSS in 2003, 18-19 years old women were more likely to gain greater than ideal weight during pregnancy (48.9%). Older women (40 years and older) were more likely to gain below ideal weight compared to all other age groups (31.5%) (Figure 13). Very young women (less than 15 years) showed the largest proportion of adequate maternal weight gain (39.3%).



Only 26.7% of women who were overweight before pregnancy gained ideal gestational weight, while 63.4% of them gained greater than that recommended by IOM. The highest percentage of normal gestational weight gain occurred from the group of women with low prepregnancy weight (45.1%) (Figure 14).



In the Missouri PNSS 2003 population, women who gained less than ideal weight during pregnancy were more likely to deliver preterm (18.0%), low birthweight (14.7%), and full term low birthweight (6.4%) babies than those who gained the recommended weight (12.6% , 8.6%, and 4.1%, respectively); while women with greater than ideal gestational weight gain were more likely to have an infant with high birthweight (10.1%) than women with ideal (5.2%) or less than ideal (3.4%) weight gain during pregnancy (Figure 15).



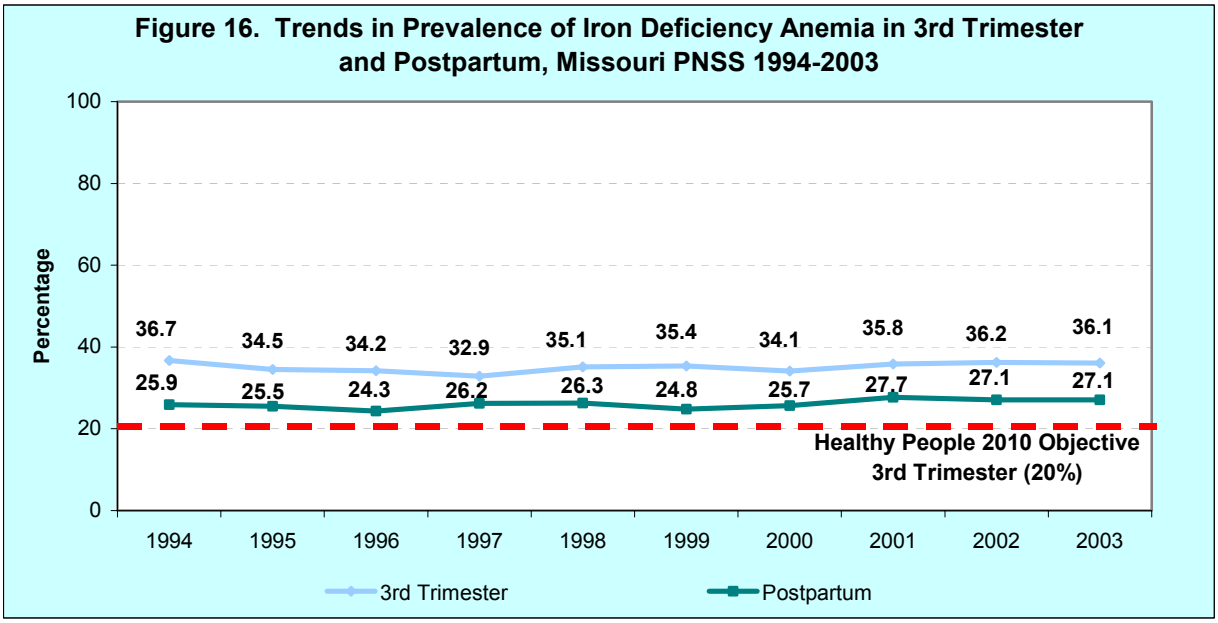
Maternal Anemia[7]

Iron deficiency anemia during pregnancy is defined as less than the 5th percentile of the distribution of hemoglobin (Hb) or Hematocrit (Hct). The distribution and cut-off values in the PNSS vary by trimester for pregnant women and are different from those for non-pregnant women. Pregnant women are at a higher risk for iron deficiency anemia because of increased iron requirements of pregnancy. The normal physiologic changes are reflected in the CDC trimester-specific criteria for anemia during pregnancy [12].

Causes of iron deficiency anemia in pregnant women are numerous and multifaceted. Iron-poor diet has been considered as the major cause of this disorder [13]. Cigarette smoking is a risk factor for having low hemoglobin/Hematocrit, because it decreases absorption of micronutrients in the intestine [14]. That is why iron deficiency and iron deficiency anemia could be easily treated with an excellent outcome [15]. Treatment may include an iron-rich diet, iron supplements and multivitamin consumption [16].

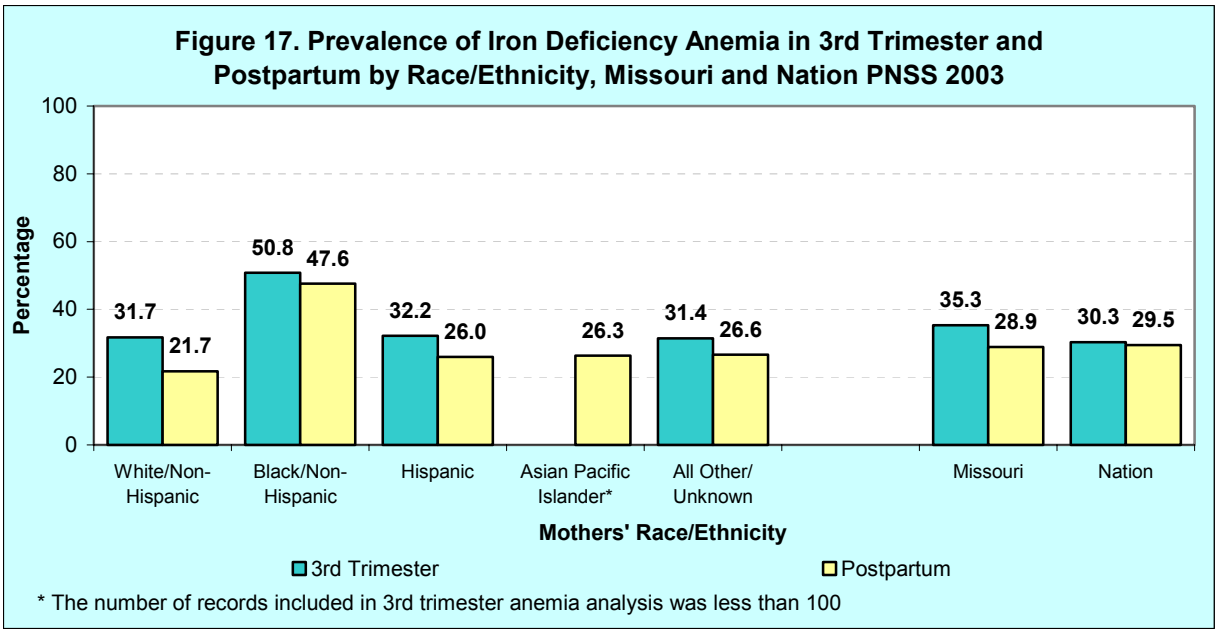
Iron deficiency anemia during the first two trimesters of pregnancy has been associated with inadequate gestational weight gain, a double risk for preterm delivery, and a 3 times higher risk for delivering a low-birth infant [17]. Longitudinal studies have shown that the highest prevalence of iron deficiency anemia during pregnancy is in the third trimester [18]; therefore, the Healthy People 2010 objective monitors the prevalence of iron deficiency anemia during the third trimester of pregnancy. This objective seeks to reduce iron deficiency anemia in the third trimester among low-income women to 20% in 2010.

The prevalence of iron deficiency anemia among women participating in the Missouri PNSS during the10 previous years has fluctuated between 32.9% and 36.7% in the 3rd trimester of pregnancy, and 24.3%-27.7% postpartum (Figure 16).



[7] Refer to the maps in Appendix 5 to see prevalence of low hemoglobin/hematocrit in 3rd trimester of pregnancy by county, and Appendix 6 for prevalence of low hemoglobin/hematocrit postpartum by county (Missouri PNSS 2001-2003 combined years)

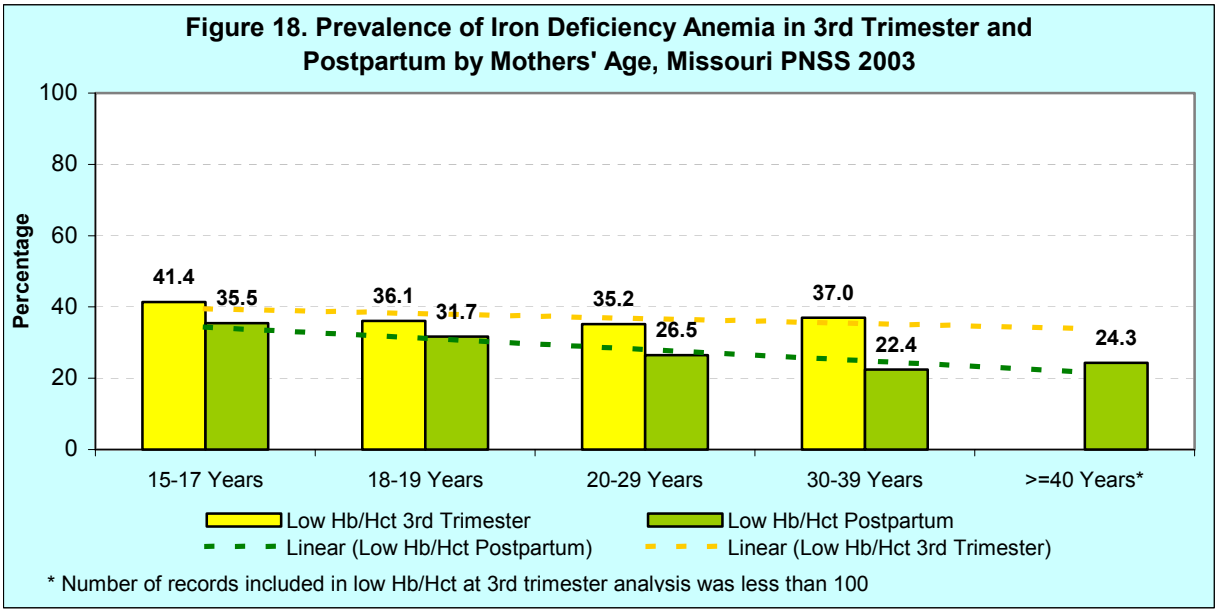
According to the 2003 PNSS, Missouri's risk for iron deficiency anemia was greater in the 3rd trimester than that reported at the national level (Figure 17)[8]. The prevalence of iron deficiency anemia in the Missouri 2003 PNSS varied among racial and ethnic groups. Black/Non-Hispanic women were at a higher risk compared to all other race/ethnic groups – 50.8% of Black/Non-Hispanic participants were diagnosed with iron-deficiency anemia during the 3rd trimester, which was 1.6 times greater than the prevalence for White/Non-Hispanic women (31.7%); and 47.6% of Black/Non-Hispanic women had low hemoglobin or Hematocrit after delivery, which was 2.2 times greater than the proportion among White/Non-Hispanic Missouri PNSS participants (21.7%)[9].



[8] American Indian/Alaskan Native group is not presented in the figure since less than 100 records were available for analysis after exclusion

[9] Many studies have approved a higher prevalence of iron deficiency anemia in Black/Non-Hispanic women. One of the explanations could be a difference in dietary habits (Siega-Ritz AM, Bodnar LM, Savitz DA, Am J Obstet Gycecol. 2002 Mar;186(3)). Also a significant hemoglobin difference for Black/Non-Hispanic and White/Non-Hispanic women was related to a different relationship between hemoglobin and transferrin saturation for the two racial groups (Meyers LD, Habicht JP, Johnson CL. Am J Epidemiol. 1979 May:109(5)).

Another risk factor associated with the percentage of iron deficiency anemia among PNSS participants is age. The highest prevalence of iron-deficiency anemia in 2003 Missouri PNSS participants was in women aged 15-17 years (41.4% in 3rd trimester and 35.5% after delivery). During the third trimester of pregnancy, the prevalence of iron deficiency anemia was slightly decreased with increasing age, except for the group aged 30-39 years that experienced a slight increase in iron deficiency anemia from the previous age group. During the postpartum period there was a consistent decrease in the prevalence of iron deficiency anemia with increasing age from 35.5% among 15-17 years old women to 22.4% in 30-39 years old women (Figure 18).

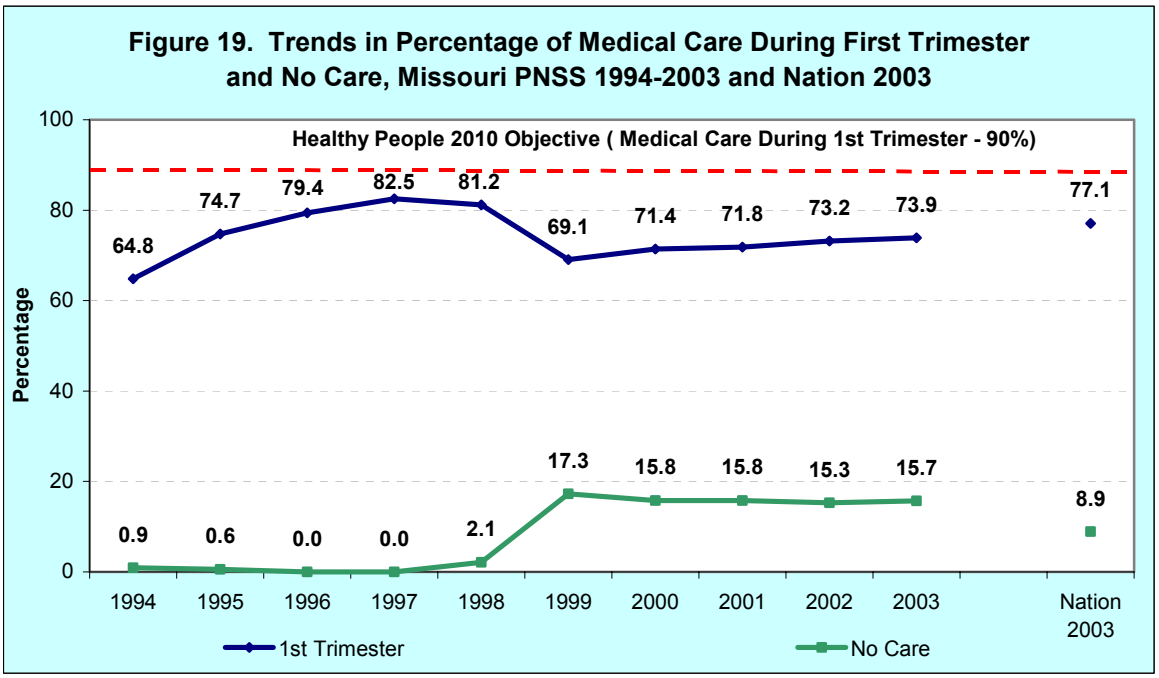


Medical Care[10]

Prenatal care has long been endorsed as a means to identify mothers at risk of delivering a preterm or growth-retarded infant and to provide an array of available medical, nutritional, and educational interventions intended to reduce the determinants and incidence of low birth weight and other adverse pregnancy conditions and outcomes. Women who begin prenatal care after the first trimester are at a higher risk for poor pregnancy outcomes with infants being born premature, low birthweight or growth retarded [19]. One of the Healthy People 2010 objectives is to increase prenatal care beginning in the first trimester of pregnancy to 90%.

Medical Care in the PNSS indicates the month in which prenatal care began for the current pregnancy. Medical care data are always collected at the prenatal visit and must also be collected at the postpartum visit if the mother was not enrolled in the WIC program during the pregnancy, or if she reported at the prenatal visit that she had not begun medical care.

Almost three fourths of Missouri PNSS participants in 2003 received medical care during the first trimester of pregnancy. The prevalence was slightly higher in 2003 (73.9%) than in previous years, but still lower than in the National PNSS population in 2003 (77.1%). In the 2003 Missouri PNSS, women have been 1.8 times more likely to report no prenatal care compared to the National PNSS population (Figure 19).

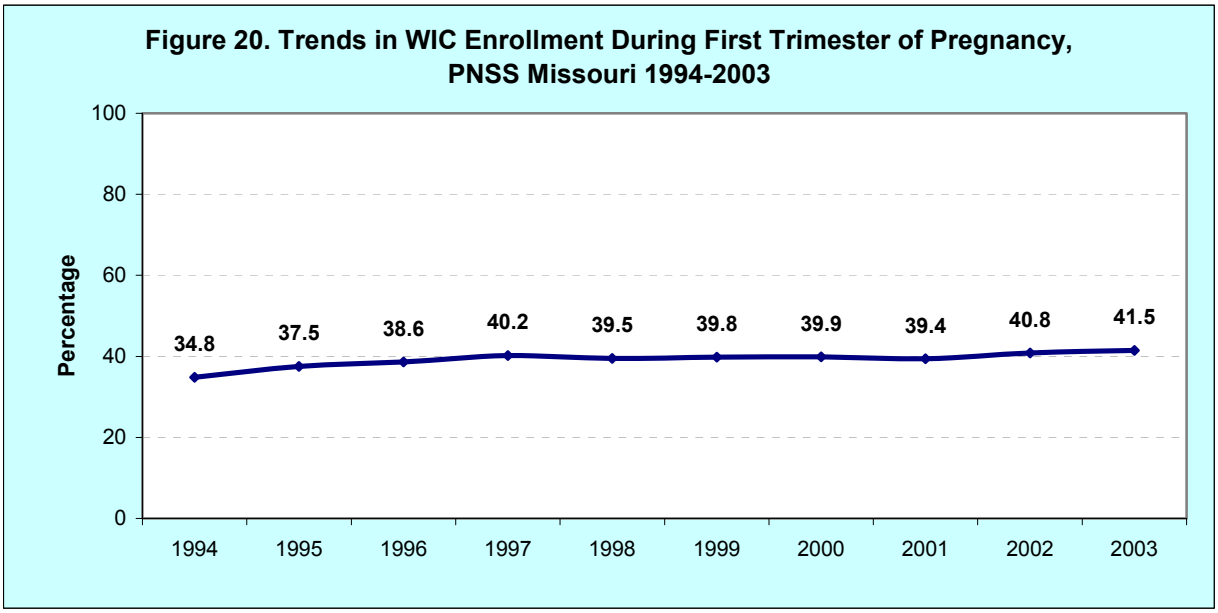


[10] Refer to the map in Appendix 7 to see the percentage of WIC participating women with no medical care during pregnancy (Missouri PNSS 2001-2003 combined years)

WIC Enrollment[11]

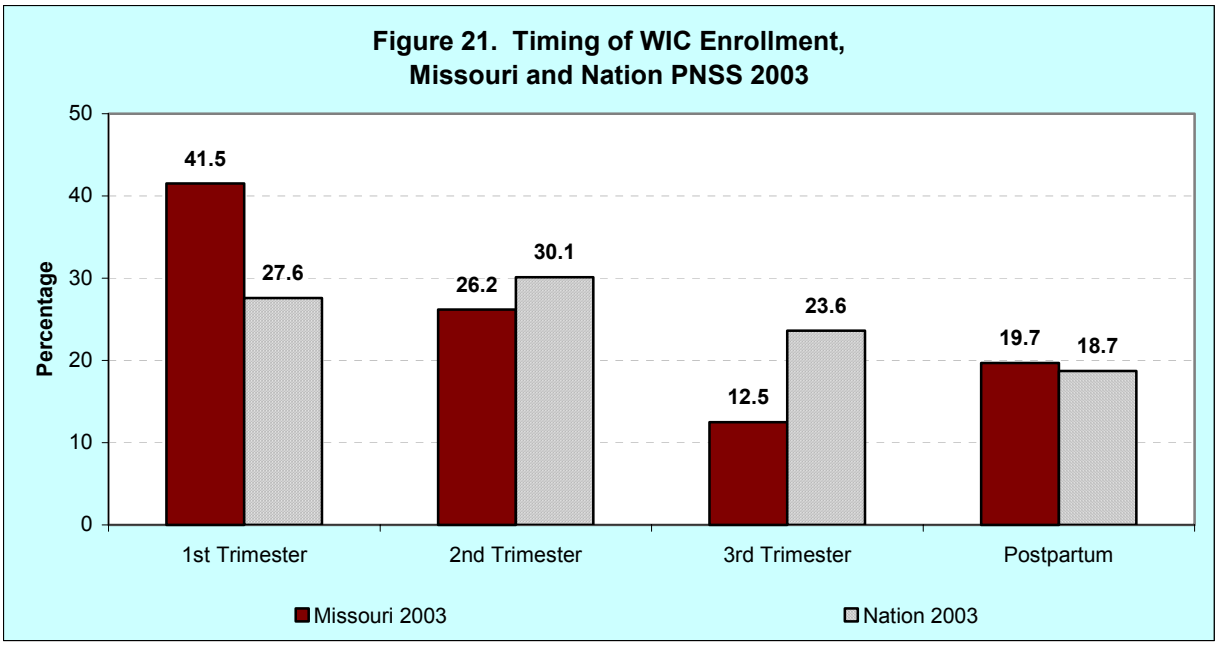
A number of studies have shown that enrollment in WIC is associated with a lower prevalence of small-for-gestational-age deliveries [20] and reduction of preterm delivery [21]. In addition, longer enrollment in the WIC program was associated with a reduced risk of low birthweight. Women participating in WIC showed better dietary intake and prenatal weight gain than those who did not participate [22].

The percentage of women in Missouri entering WIC during the first trimester of pregnancy has been increasing during the last 10 years (Figure 20) and reached its highest point in 2003 (41.5%).



[11] Refer to the map in Appendix 8 to see percentage of women enrolling in WIC during 1 st trimester of pregnancy by county (Missouri PNSS 2001-2003 combined years)

In the 2003 Missouri PNSS, the percentage of women who enrolled in the WIC program during the first trimester of pregnancy was higher than in the 2nd and 3rd trimesters, or postpartum, while in the national PNSS data for 2003, the largest proportion of women enrolled in WIC occurred in the 2nd trimester (Figure 21).



Smoking During Pregnancy[12]

Smoking during pregnancy increases the risk of miscarriage, premature birth, and infant death, including sudden infant death syndrome (SIDS or "crib death"). It is widely known that women who smoke during pregnancy are more likely to have low birthweight babies. In the 2003 Missouri PNSS, the percentage of women who did not smoke during pregnancy and had low birthweight babies was 7.2%, but the percentage of women who smoked and had low birthweight babies was 9.8%.

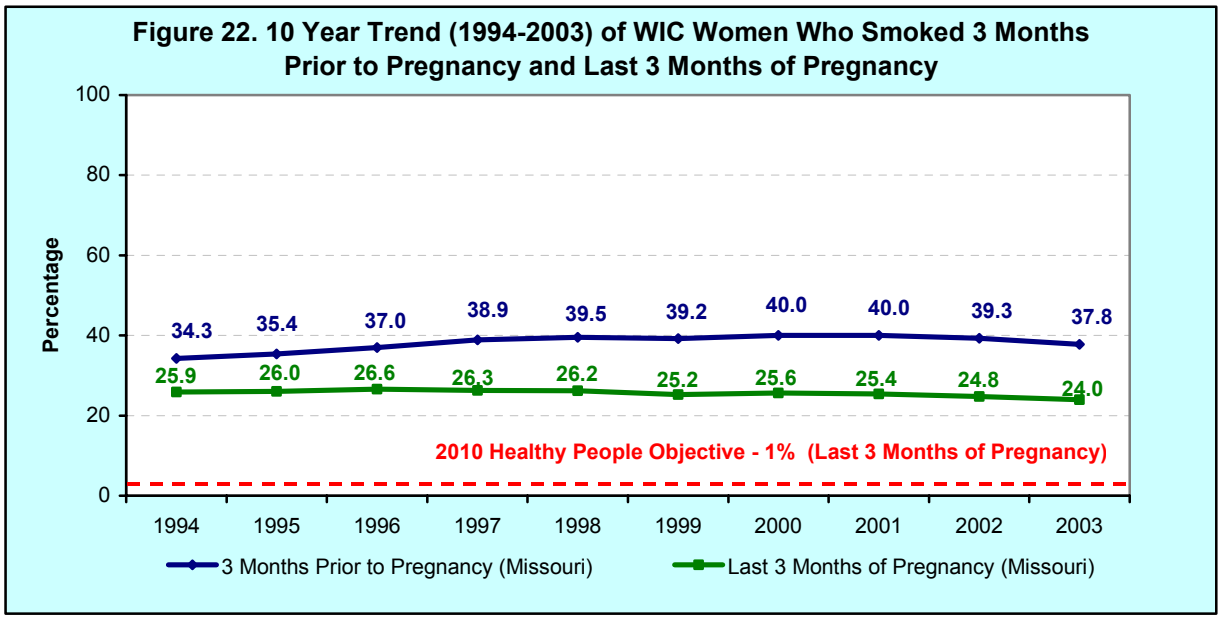
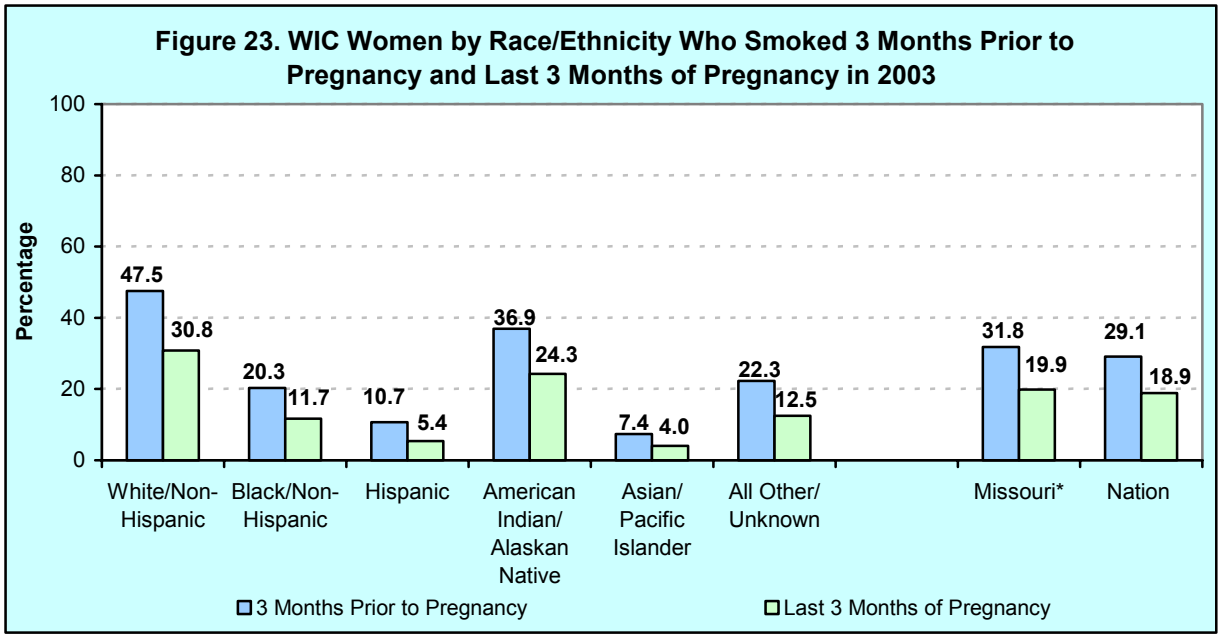


Figure 22 shows the 10-year trend (1994-2003) of the percentage of women in the WIC program who smoked 3 months prior to pregnancy and the last 3 months of pregnancy. The year that WIC women had the lowest rate of smoking 3 months prior to pregnancy was 1994 (34.3%). Since that year, the rate for this indicator continued to increase to a high of 40% in 2000 and 2001. However, since 2001, the rate has been steadily decreasing.

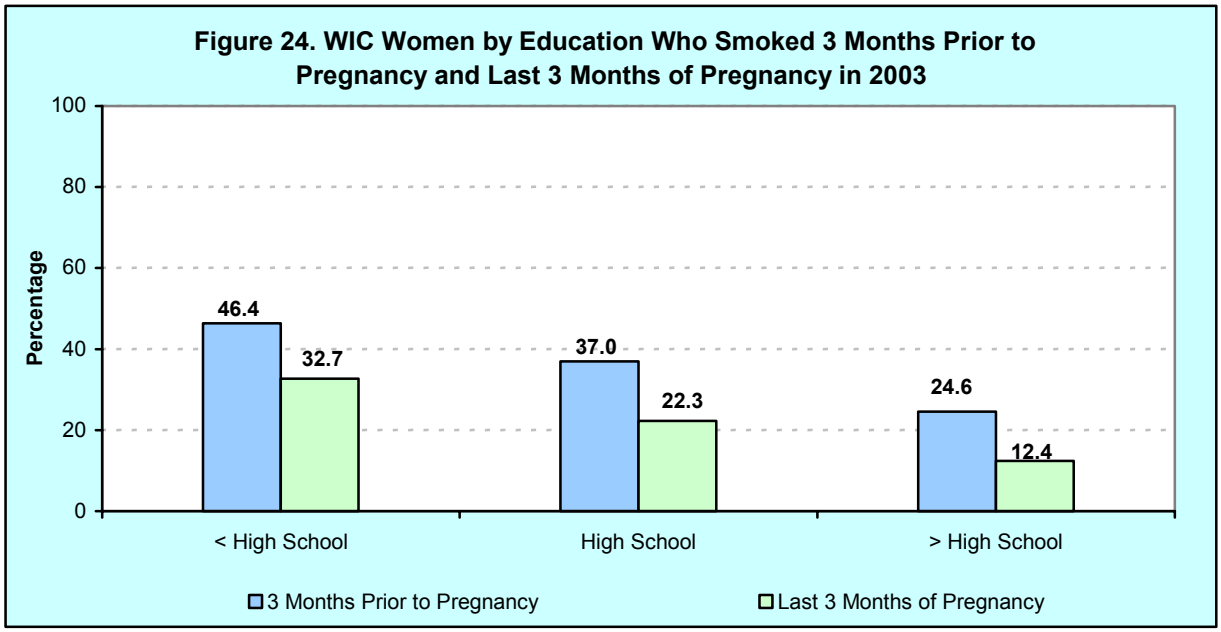
In comparison, the trend for WIC women who smoked the last 3 months of pregnancy is more stable. Figure 22 shows that in each year about one third of WIC women who smoked 3 months prior to pregnancy quit smoking after they were aware of their pregnancy and the harm of smoking to pregnancy. However, there were still about one fourth of the WIC pregnant women who smoked each year from 1994 to 2003. The 2010 Healthy People objective is to reduce the rate of cigarette smoking during the last 3 months of pregnancy to 1%.

[12] Refer to the map in Appendix 9 to see percentage of women who smoked last 3 months of pregnancy by county (Missouri PNSS 2001-2003 combined years)



* Adjusted prevalence.

Figure 23 shows that White/Non-Hispanic women in WIC had the highest rate of smoking 3 months prior to pregnancy (47.5%) and the women of Asian/Pacific Islander origin had the lowest rate (7.4%). The difference between or among the race/ethnicity groups indicates that culture origin had a strong impact on smoking behaviors.



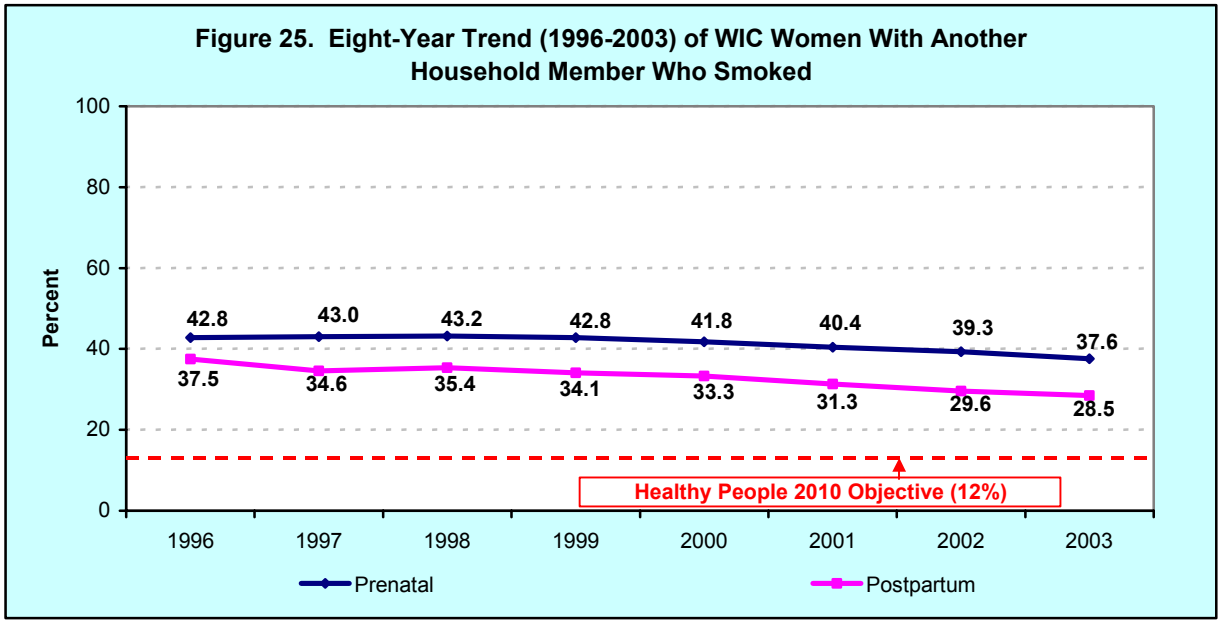
Educational level also had a strong impact on WIC women's smoking behaviors. The higher the level of education that a WIC woman had received, the less likely she would smoke prior to or during pregnancy. Figure 23 shows that the rates of WIC women who smoked 3 months prior to pregnancy and the last 3 months of pregnancy were highest among those who received less than a high school education (46.4% and 32.7%, respectively). In contrast, the rates for those who

had received greater than a high school education were lowest on these two indicators (24.6% and 12.4%, respectively).

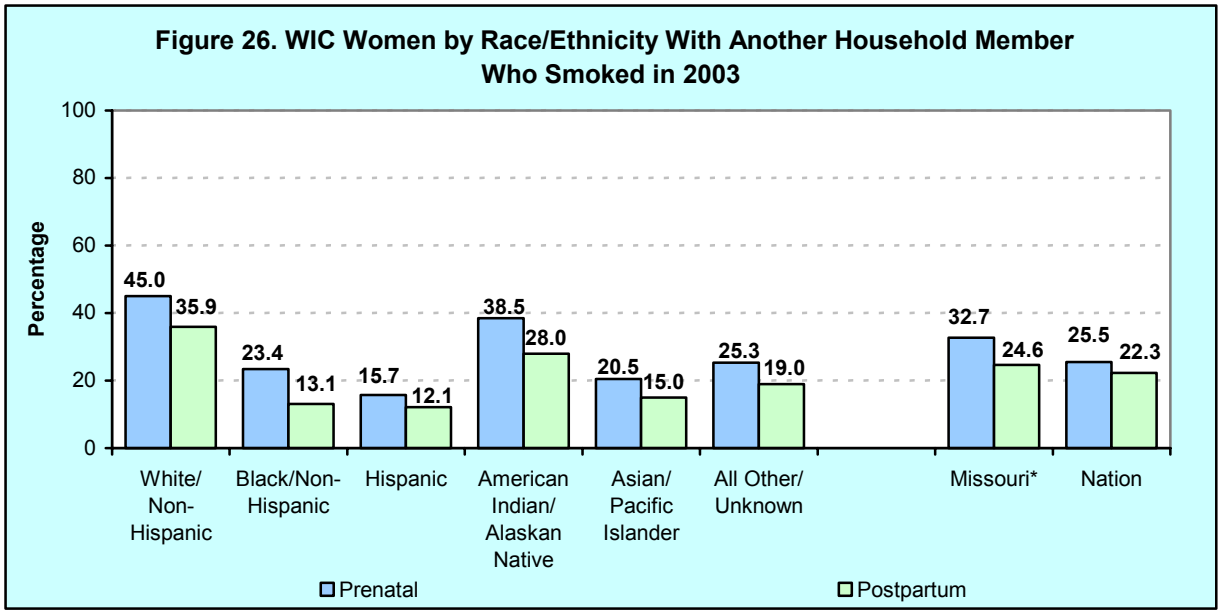
Secondary Smoke from Other Household Members

Secondary smoke from other household members is also unhealthy during pregnancy, and after birth as well. Babies exposed to secondary smoke are more likely to have respiratory infections and colds. The 8-year trend data (1996-2003, data were not available prior to 1996 on this indicator) show that before 2002, more than 40% of WIC women in the prenatal period and more than 30% of WIC women in the postpartum period lived with other household members who were smokers (Figure 25).

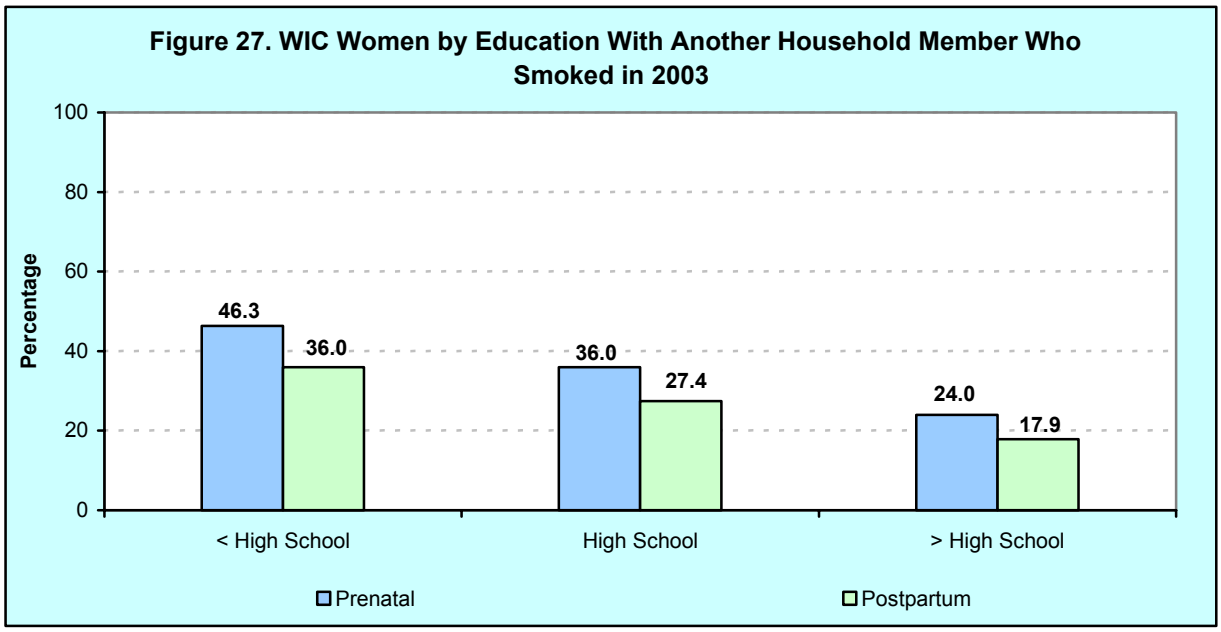
Even though decreasing trends have been observed for these two indicators since 1996, the 2003 data show that the differences between the Missouri situations and the objective of Healthy People 2010 (reduce tobacco use by adults to 12%) are still large.



Again, race/ethnicity had an impact on the rate of smoking from other household members. During the time of pregnancy, household members of White/Non-Hispanic women and American Indian/Alaskan Native women had the highest rates of smoking (45.0% and 38.5%, respectively) (Figure 26). Comparatively, Hispanic women and Asian/Pacific Islander women had the lowest rates (15.7% and 20.5%, respectively) on this indicator. The rate of secondary smoke in the household was still highest for White women (35.9%) after their children were born, and the rate for the Hispanic women was still the lowest (12.1%).



*Adjusted prevalence.



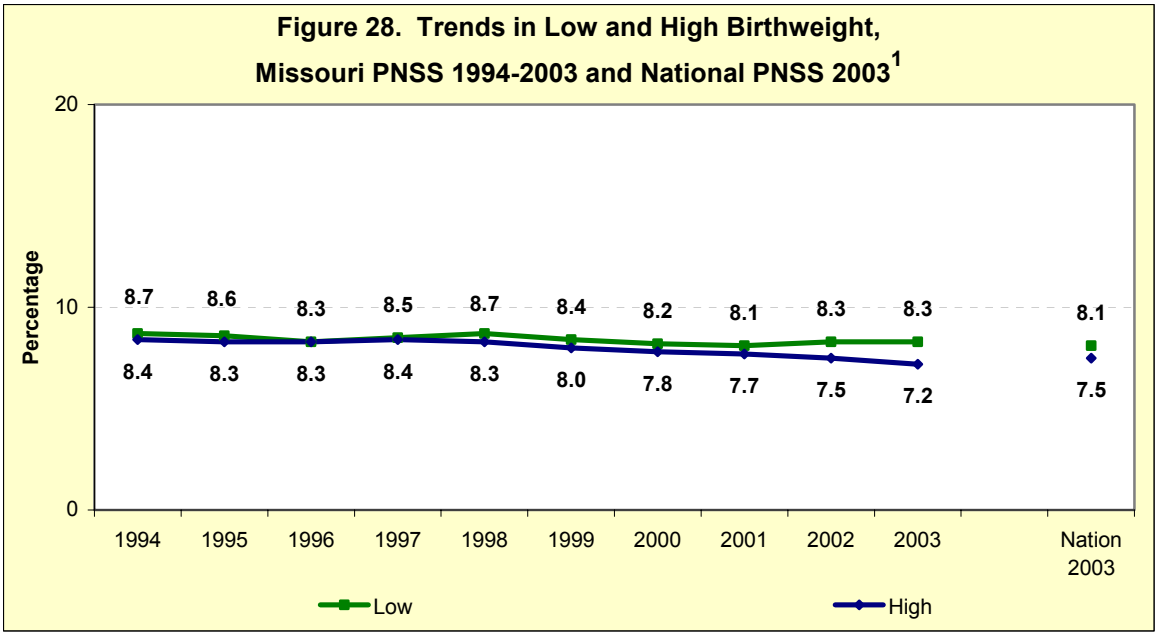
WIC women's educational level also had an impact on the rate of secondary smoking in the household. Figure 27 shows that the higher the educational level of a WIC woman, the less likely this woman would have another household member who smokes.

INFANT HEALTH INDICATORS

Low or High Birthweight[13]

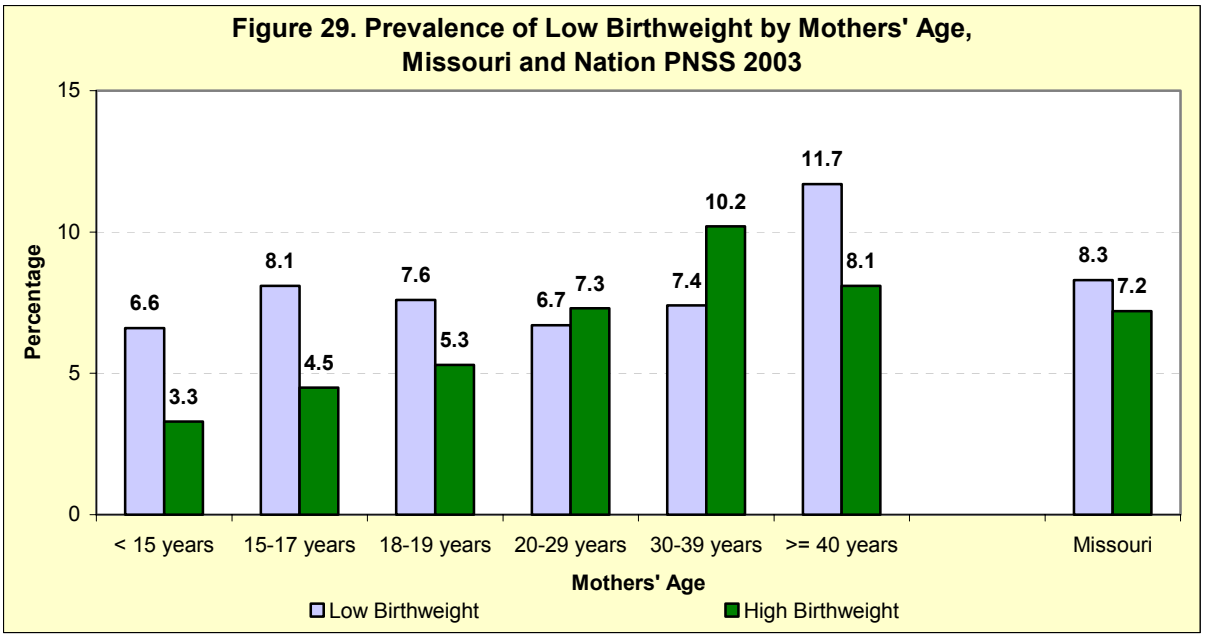
Low birthweight (less than 2,500 grams or 5.5 pounds) is a major determinant of neonatal mortality and post-neonatal mortality [23]. Infants with low birthweight are more likely to experience developmental delays and disabilities than infants with normal birthweight [24]. The most important factors for low birthweight are cigarette smoking [25], followed by nutrition and pre-pregnancy weight. In addition, teenage mothers are at a higher risk for low birthweight [26]. Socioeconomic factors were strongly associated with low birth weight [27]. An objective included in Healthy People 2010 is to reduce low birthweight to less than 5%. High birthweight (greater than 4,000 grams) significantly increases the risk of injuries such as shoulder dystocia. Mortality rates are higher among overweight full-term infants compared to infants weighing between 3,000 and 4,000 grams [28].

In the 1994-2003 Missouri PNSS, the percentage of low birthweight has not been changing noticeably, while the proportion of babies born overweight has been decreasing slowly from 8.3% in 1994 to7.2% in 2003 (Figure 28)[14]. The 2003 prevalence in the Missouri and National PNSS were similar for both indicators.



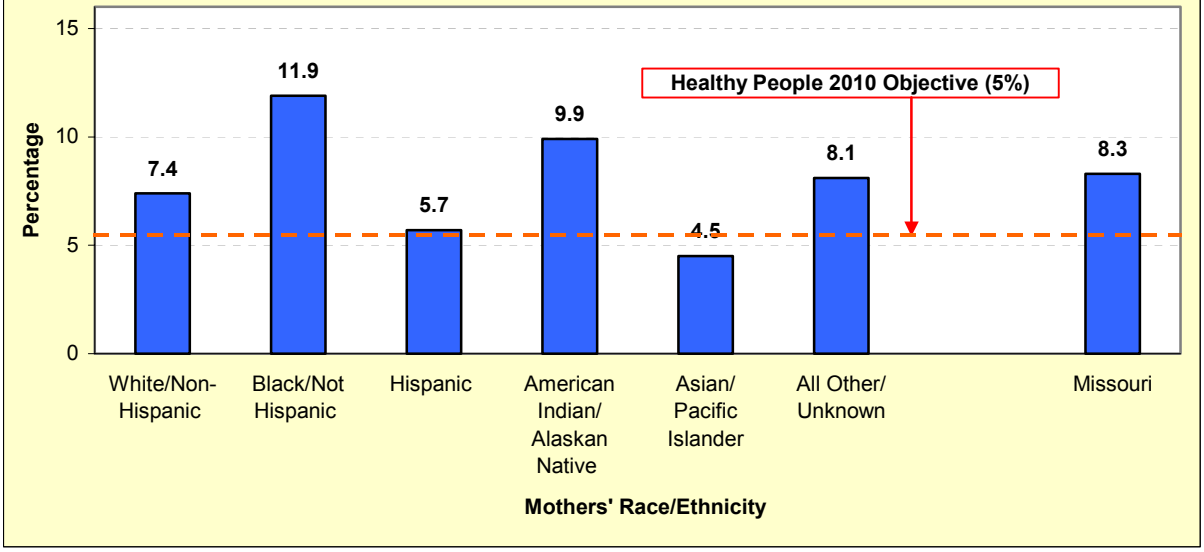
[13] Refer to the maps in Appendix 10 to see prevalence of low birthweight by county, and Appendix 11 for prevalence of high birthweight by county (Missouri PNSS 2001-2003 combined years)
[14] To show more details, a 20% scale was used in Figure 28.

As described above, both maternal prepregnancy weight and maternal weight gain can be considered as strong predictors of low or high birthweight in the Missouri PNSS population based on 2003 data (Figure 9 and Figure 15). In the 2003 Missouri PNSS, smoking was also associated with birth weight (the percentage of women who did not smoke during pregnancy and had low birthweight babies was 7.2%, but the percentage of women who smoked and had low birthweight babies was 9.8%). The risk of having a low birthweight infant was high among women 15-17 years old (8.1%) and even higher among women aged 40 years and older (11.7%) (Figure 29). Women participating in the 2003 Missouri PNSS aged 30-39 years had a larger risk to deliver a high birthweight infant (10.2%) than in all other age groups.



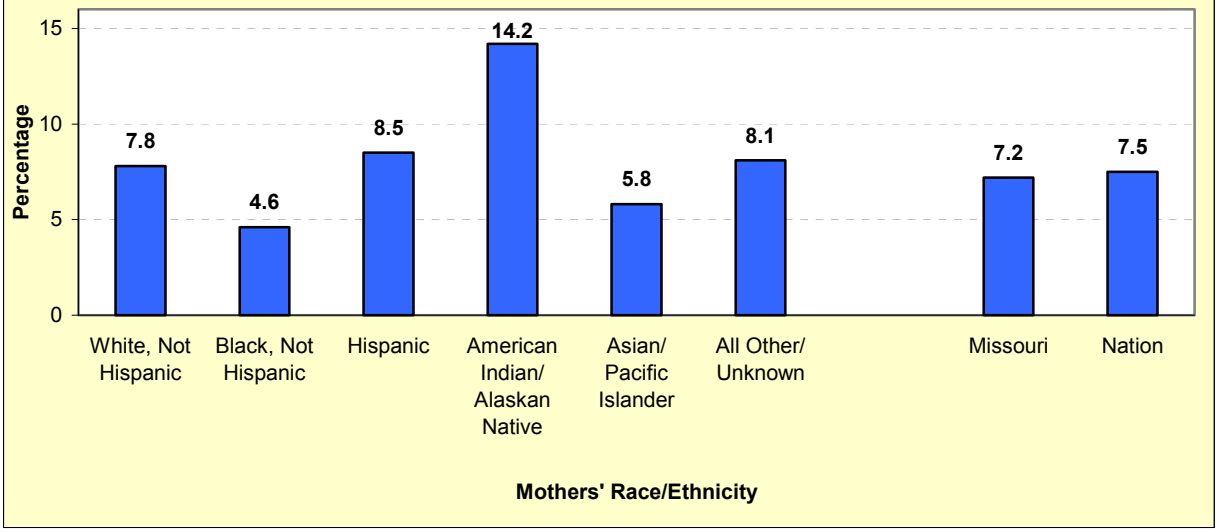
In the Missouri PNSS 2003, women from the Black/Non-Hispanic and American Indian/Alaskan Native race/ethnic group had a higher rate in delivering a low birthweight infant (11.9% and 9.9%, respectively). In fact, Black/Non-Hispanic women were two times more likely to have low birthweight babies than Hispanic women and 1.6 times more likely than White/Non-Hispanic women (Figure 30). In 2003, the proportion of infants born with low birthweight remained higher than the recommended Healthy People 2010 objective (5%). However, Hispanic women illustrated prevalence very close to the target, and Asian/Pacific Islander women reached the target.

Figure 30. Prevalence of Low Birthweight by Mothers' Race/Ethnicity, Missouri and Nation PNSS 2003



In addition, American Indian/Alaskan Native mothers were 3 times more likely than Black/Non-Hispanic mothers to deliver a high birthweight infant (prevalence of high birthweight in American Indian/Native Alaskan women in the 2003 Missouri PNSS was 14.2% and 4.6% in Black/Non-Hispanic women) (Figure 31).

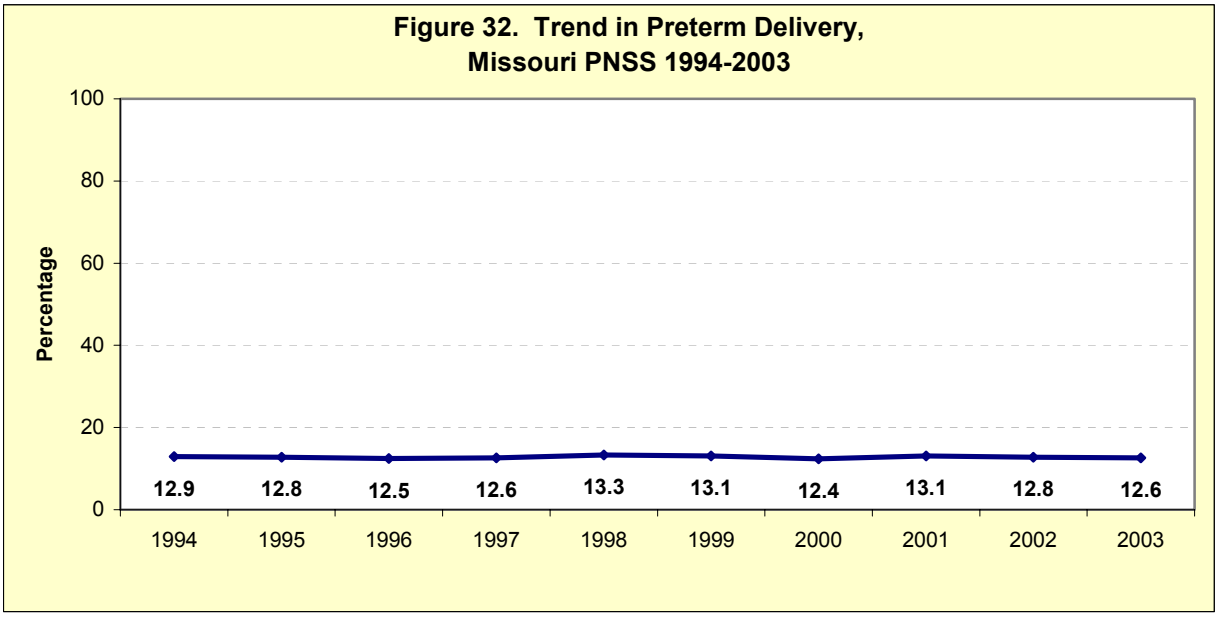
Figure 31. Prevalence of High Birthweight by Mothers' Race/Ethnicity, Missouri and Nation PNSS 2003



Preterm Delivery[15]

Preterm birth refers to delivery before 37 weeks gestation. Preterm birth has been identified as one of the most important perinatal health problems in industrialized nations [29]. An infant born prematurely is at an increased risk of neurological and respiratory disorders, ocular diseases, and death [30]. It is increasingly recognized that the prevention of preterm birth is crucial to improving pregnancy outcomes [31]. According to the Institute of Medicine, preterm births can be minimized by preventing problems like iron deficiency anemia and inappropriate gestational weight gain through nutrition intervention. A Healthy People 2010 national health objective is for not more than 7.6% of births to be premature.

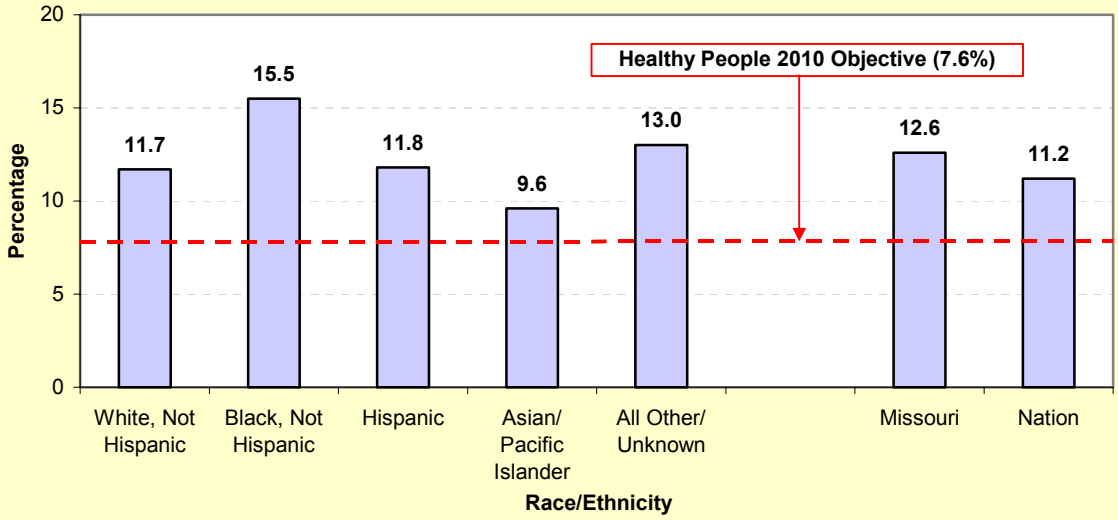
The prevalence of preterm deliveries among PNSS participants remained fairly stable from 1994 to 2003, but fluctuated somewhat between 12.4% in 2000 and 13.3% in 1998 (Figure 32).



[15] Refer to the map in Appendix 12 to see prevalence of preterm delivery by county (Missouri PNSS 2001-2003 combined years)

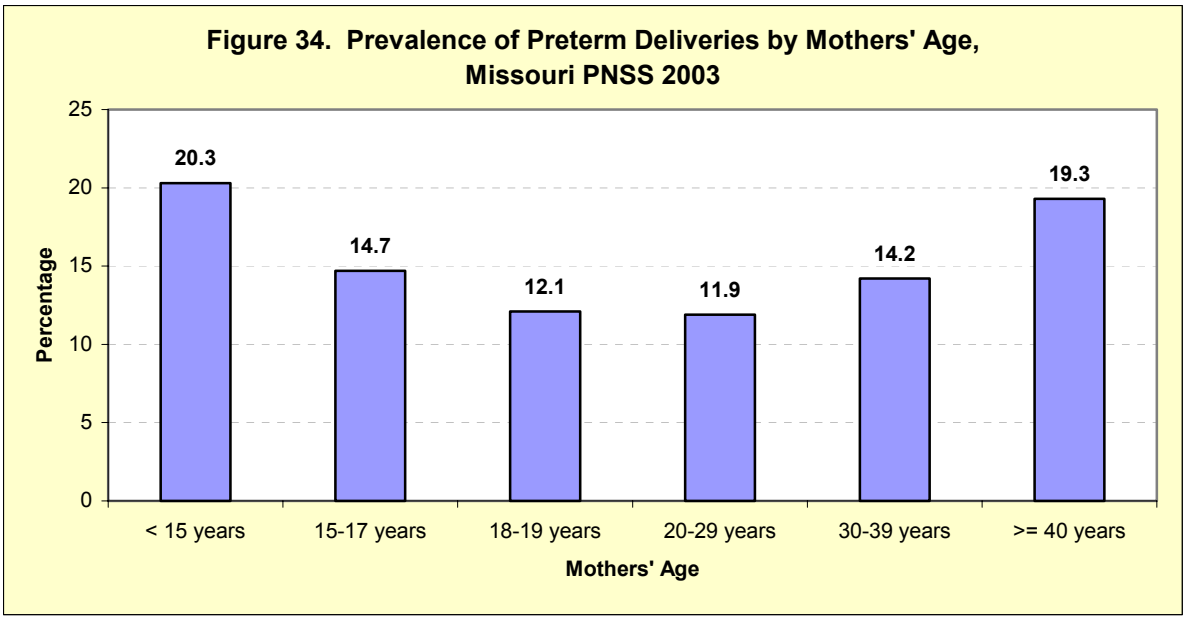
In 2003, the prevalence of preterm deliveries was higher in Missouri (12.6%) than for the National PNSS in 2003 (11.2%). In the Missouri PNSS 2003, premature birth was associated with underweight prepregnancy BMI and maternal weight gain (Figure 10 and Figure 15). Additionally, the prevalence of preterm deliveries varied in different race/ethnic groups of mothers (Figure 33)[16]. In 2003, the highest rate was for Black/Non-Hispanic PNSS participants (15.5%) and the lowest proportion of preterm births was among Asian/Pacific Islander mothers (9.6%).

Figure 33. Prevalence of Preterm Births by Mothers' Race/Ethnicity, Missouri PNSS 2003



[16] American Indian/Alaskan Native group is not presented in the figure since less than 100 records were available for analysis after exclusion.

In the Missouri PNSS 2003, 20.3% of preterm babies were born to the youngest mothers (less than 15 years old), which was 1.7 times more likely, compared to women aged 20-29 years (11.9%). Women 40 years and older were at a high risk of having premature deliveries, too (19.3%) (Figure 34).

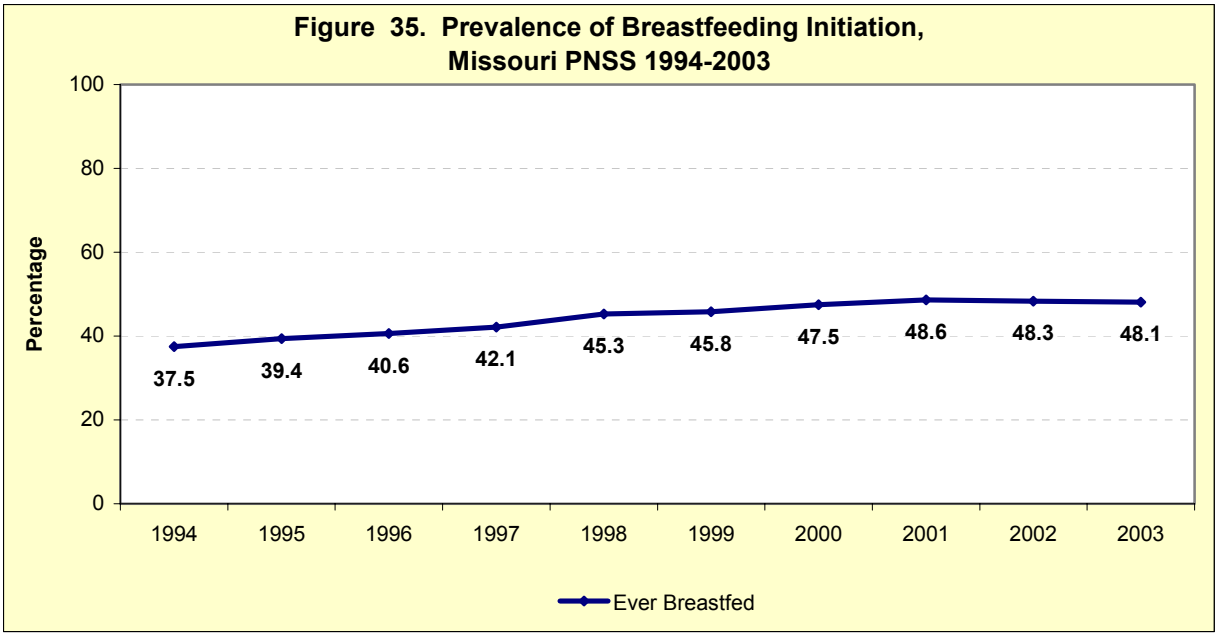


Breastfeeding Initiation

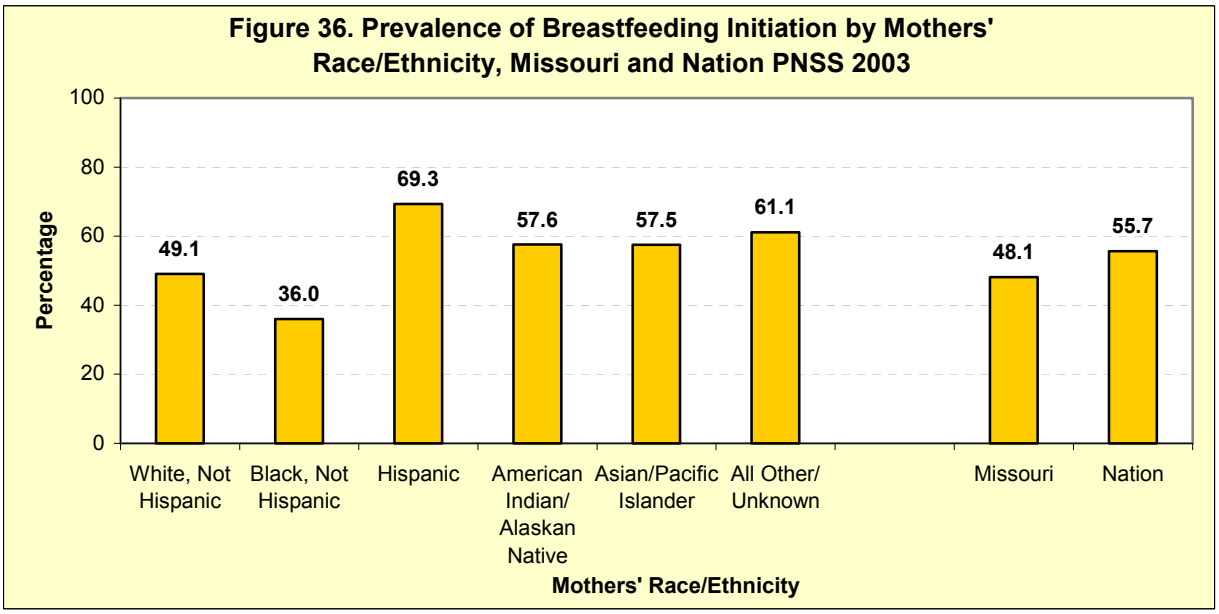
Advantages for infants, mothers, families, and society from breastfeeding were documented by many studies [32]. These advantages include health, nutritional, immunologic, developmental, psychologic, social, economic, and environmental benefits [33]. The benefits for mothers include earlier return to prepregnancy weight [34], decreased risk of breast cancer [35], and decreased risk of ovarian cancer [36]. The Healthy People 2010 national health objective for breastfeeding initiation is to increase to at least 75% the proportion of mothers who breastfeed their babies in the early postpartum period.

From 1994 to 2003, the proportion of PNSS women who initiated breastfeeding has increased from 37.5% to 48.1% (Figure 35). The prevalence still remained lower than the average of all other states contributing to PNSS in 2003; in the National PNSS the prevalence of ever breastfed was 55.7%.

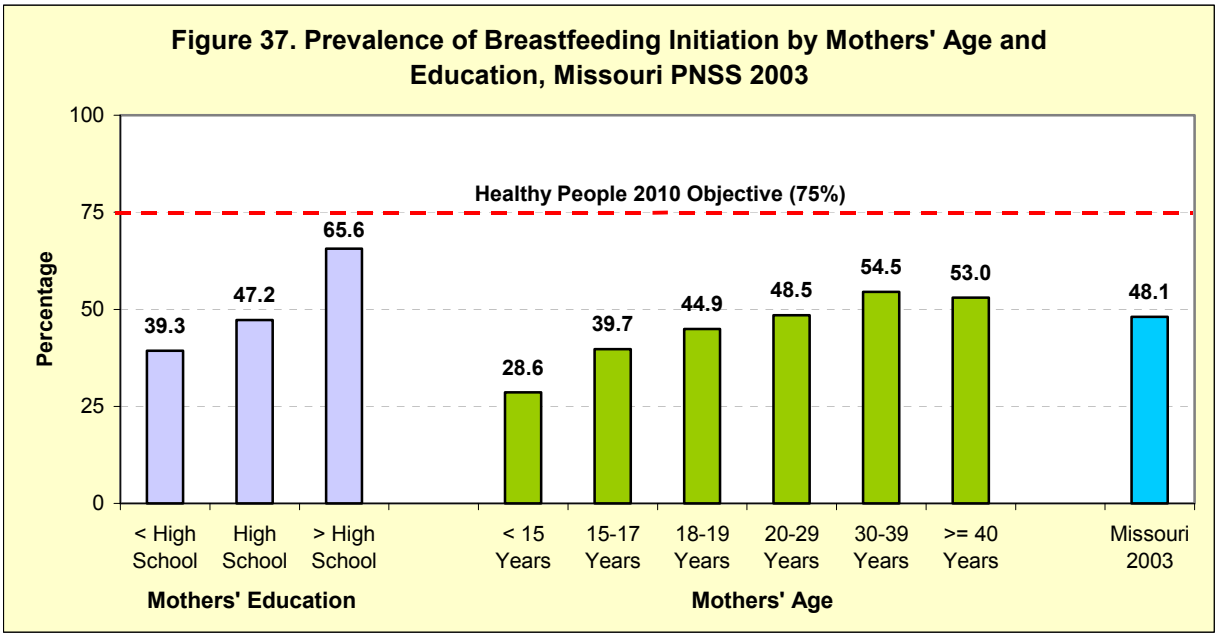
Figure 35. Prevalence of Breastfeeding Initiation, Missouri PNSS 1994-2003



In the 2003 Missouri PNSS, the rate was less than the Healthy People 2010 target of 75%. The percentage of ever breastfed varied by mothers' race/ethnicity: 36.0% of Black/Non-Hispanic infants born to PNSS mothers in 2003 were breastfed, while 69.3% of Hispanic infants were ever breastfed in the 2003 Missouri PNSS (Figure 36).



The prevalence of having ever breastfed increased with age (Figure 37). In the 2003 Missouri PNSS, participants 40 years or older were 1.8 times more likely to report breastfeeding initiation at birth compared to women younger than 15 years. The percentages of ever breastfed mothers increased with educational level (39.3% of breastfeeding initiation among women with less than high school education, 47.2% among women with high school education and 65.6% among women with greater than high school education).



Conclusions and Recommendations:

An important use of the PNSS data is monitoring the Healthy People 2010 Objectives. These objectives were designed to serve as a goal for monitoring progress towards improving the health of the nation. The 10-year trend data (from 1994 to 2003) showed some progress in increasing the proportion of pregnant women receiving medical care during the 1st trimester of pregnancy. Additionally, progress has been made in breastfeeding initiation. However, the 2010 Healthy People objectives pertaining to reduction of the percentage of low birthweight and preterm births, and the goal to reduce anemia among low-income pregnant females in the 3rd trimester have not shown progress (Table 1).

Table 1

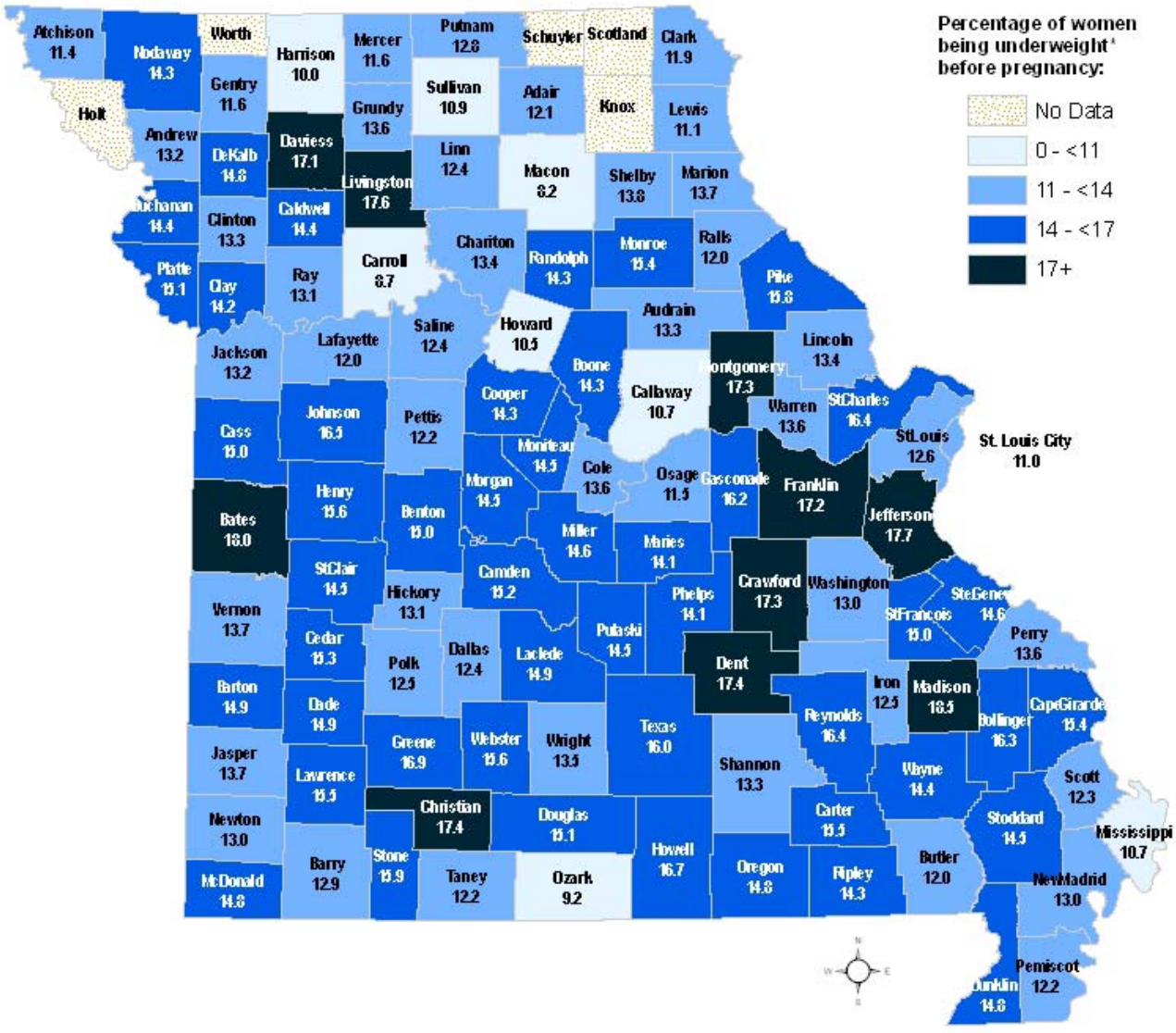
Healthy People 2010 Objectives that are relevant to the health of pregnant women and pregnancy outcomes	2003 National PNSS data	2003 Missouri PNSS data	Progress of the Missouri PNSS population during 1994-2003 years
Increase the proportion of pregnant women who receive prenatal care in the first trimester to **90%** (16-10a)	77.1	73.9	Slight Increase from 1999 to 2003
Reduce low birthweight to **5 %** (16-10b)	8.1	8.4	Stable
Reduce preterm births to **7.6%** (16-11)	11.2	12.6	Stable
Increase the proportion of women who achieve a recommended weight gain during their pregnancies (no target established)	30.6	34.6	Stable
Increase the proportion of pregnant women who report abstinence from cigarette smoking during previous month to **99%** (16-17c)	81.1	76.0	Stable
Increase the proportion of mothers who breast feed in the early postpartum period to **75%** (16-19a)	55.7	48.1	Increase
Reduce anemia among low-income pregnant females in their third trimester to **20%** (19-13)	30.3	36.1	Stable

The 2003 Missouri PNSS data indicate that state and community public health programs are needed to support the following interventions to meet the national and state health goals for maternal and child nutrition in low-income populations:

- Increase efforts in promoting early identification of pregnancy and early entry into comprehensive prenatal care, including medical care and WIC program services.
- Ensure that counseling for women who plan to have more children includes weight control and management. Women who are underweight before pregnancy should be encouraged to gain some weight to reach normal prepregnancy weight to prevent complications, such as low birthweight and preterm delivery. In contrast, women who are overweight or obese before pregnancy could be counseled on how to manage weight to prevent the related negative birth outcomes such as high birthweight
- Encourage a recommended pregnancy weight gain, based on prepregnancy weight status, especially for young mothers (15-19 years old) and women who are overweight before pregnancy.

- Support nutrition education focused on iron rich foods and iron absorption-enhancing foods to help reduce the percentage of women with low hemoglobin/Hematocrit participating in PNSS. Also, promote adequate multivitamin consumption and iron intake during pregnancy to decrease the risk of having iron deficiency anemia.
- Encourage early enrollment of pregnant women into medical care programs and the WIC program to better help pregnant women obtain all the important information and counseling needed, such as the harm of smoking and drinking and the benefit of appropriate food intake.
- Continue establishment of breastfeeding as a social norm. Programs combining breastfeeding education with behaviorally-oriented counseling were associated with increased rates of breastfeeding initiation and its continuation for up to 3 months [37].

Prevalence of Prepregnancy Underweight*, by County (Missouri PNSS 2001-2003 Combined Years)



* BMI < 19.8

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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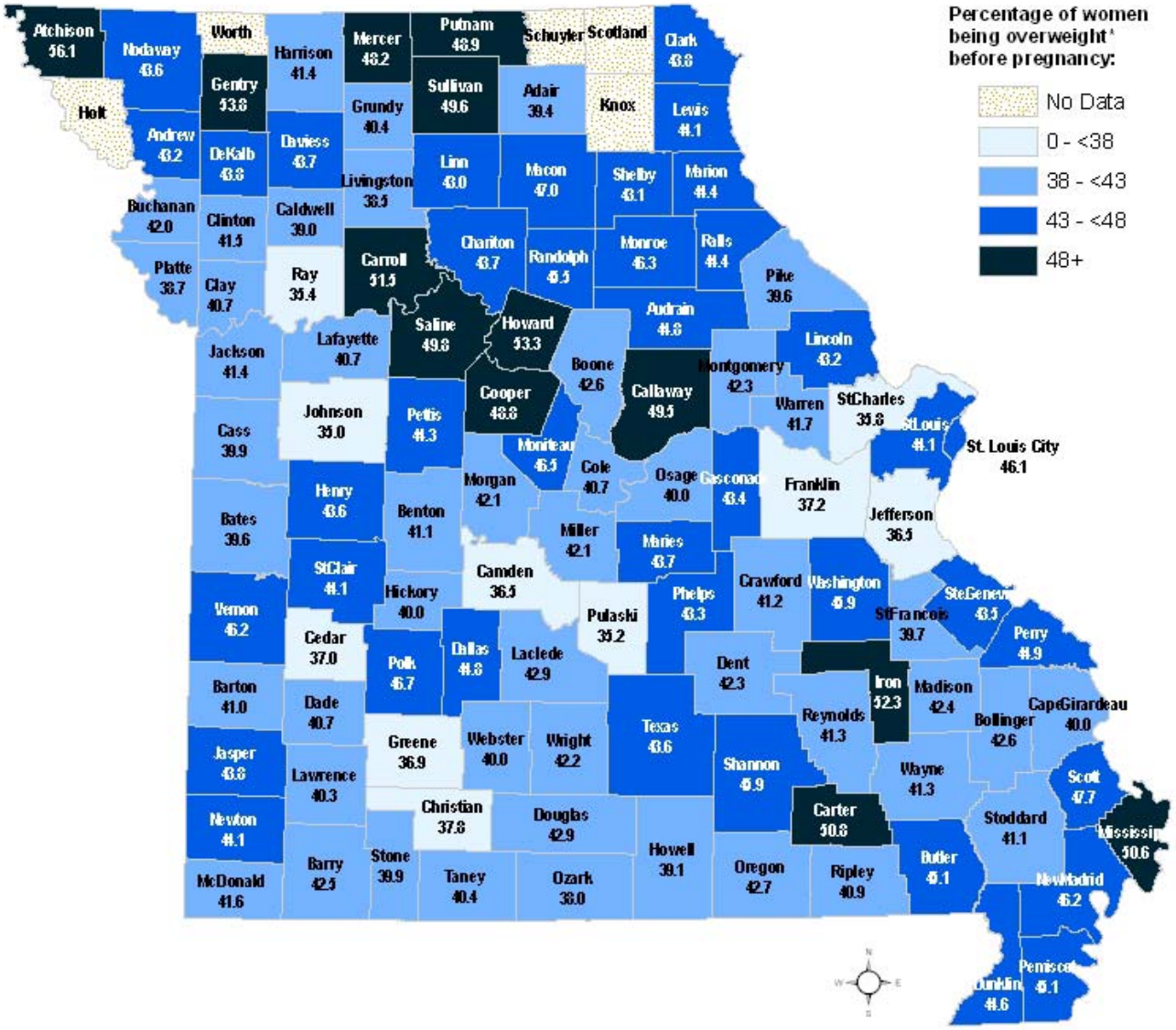
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kaluzna, Research Analyst II
08/30/2005

Prevalence of Prepregnancy Overweight*, by County (Missouri PNSS 2001-2003 Combined Years)



* BMI >= 26.5

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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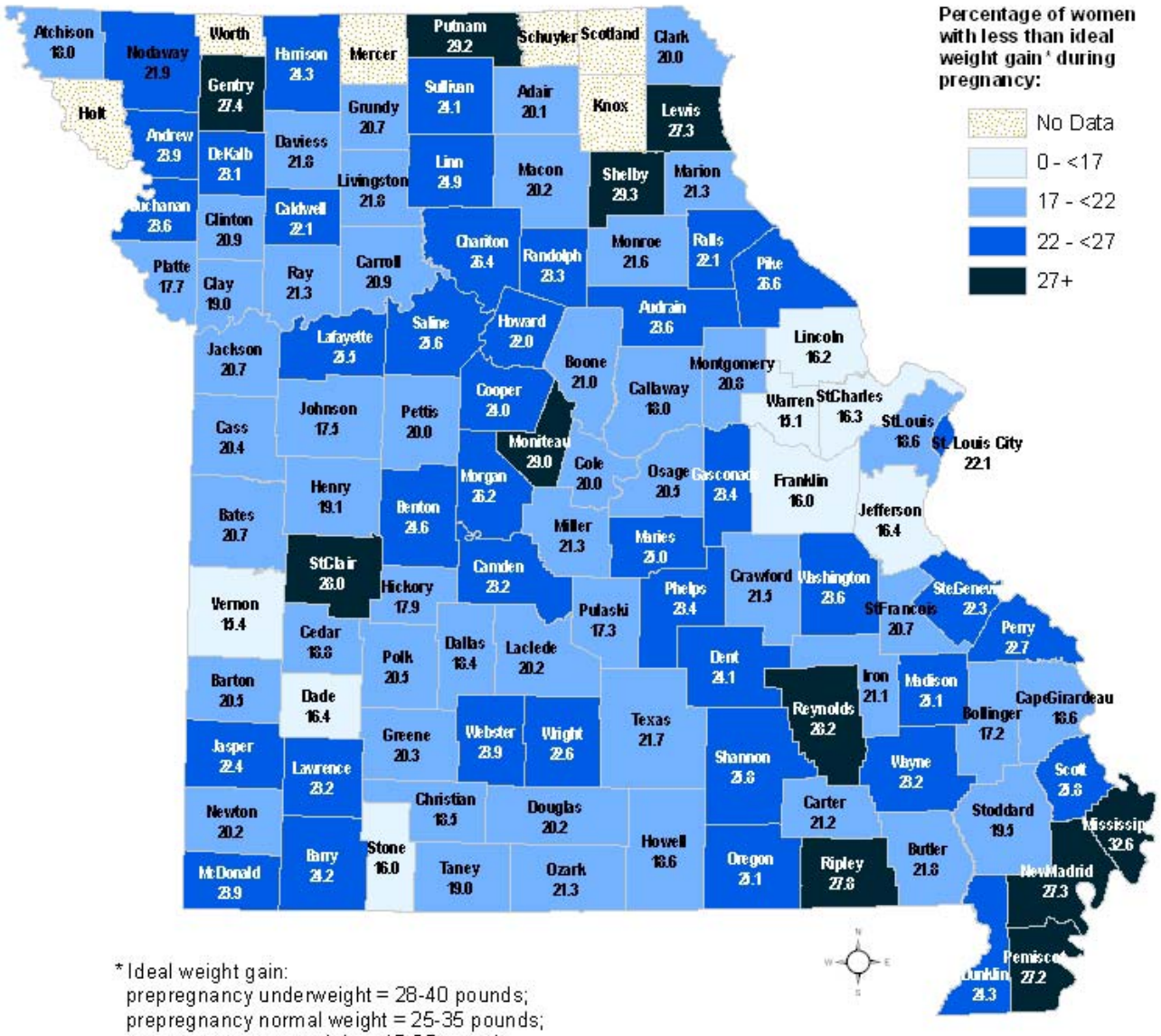
Surveillance and Epidemiology
Kateryna Kalugina, Research Analyst II
08/30/2005

Prevalence of Less Than Ideal Maternal Weight Gain*, by County (Missouri PNSS 2001-2003 Combined Years)



*Ideal weight gain:
prepregnancy underweight = 28-40 pounds;
prepregnancy normal weight = 25-35 pounds;
prepregnancy overweight = 15-25 pounds

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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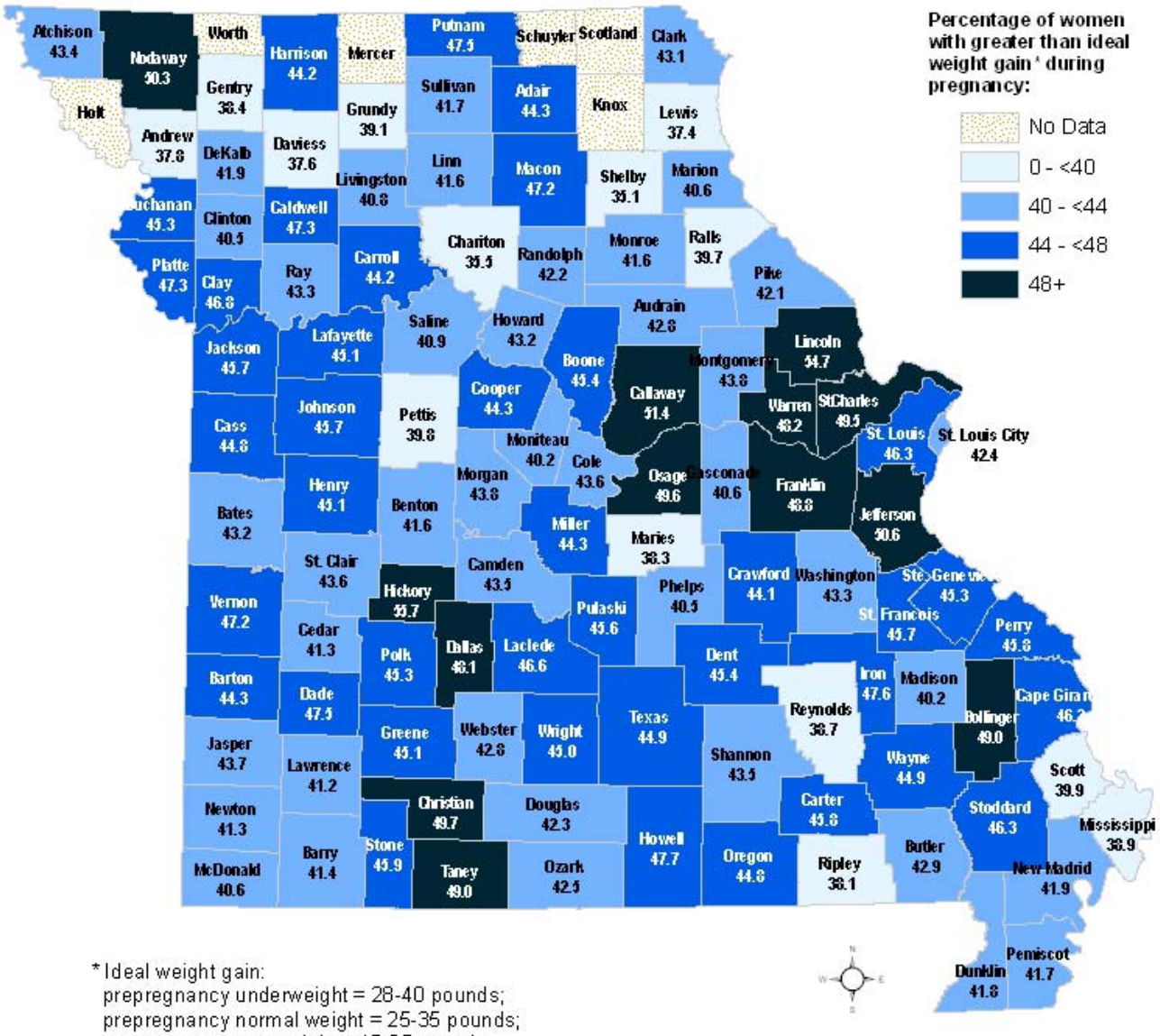
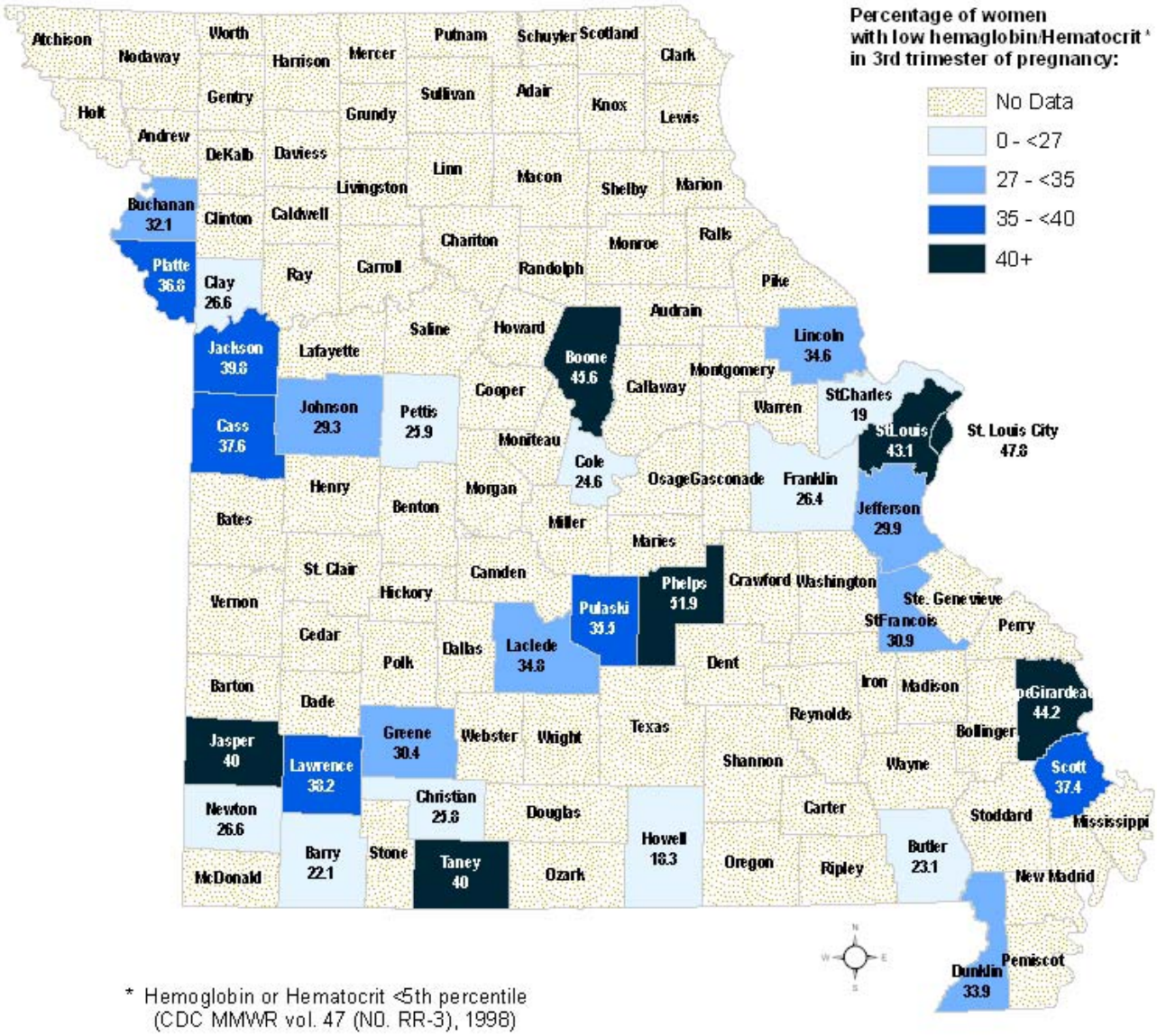


* Ideal weight gain:
prepregnancy underweight = 28-40 pounds;
prepregnancy normal weight = 25-35 pounds;
prepregnancy overweight = 15-25 pounds

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

Division of Community and Public Health
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Halugina, Research Analyst II
08/30/2005

Prevalence of Low Hemoglobin/Hematocrit* in 3rd Trimester of Pregnancy, by County (Missouri PNSS 2001-2003 Combined Years)

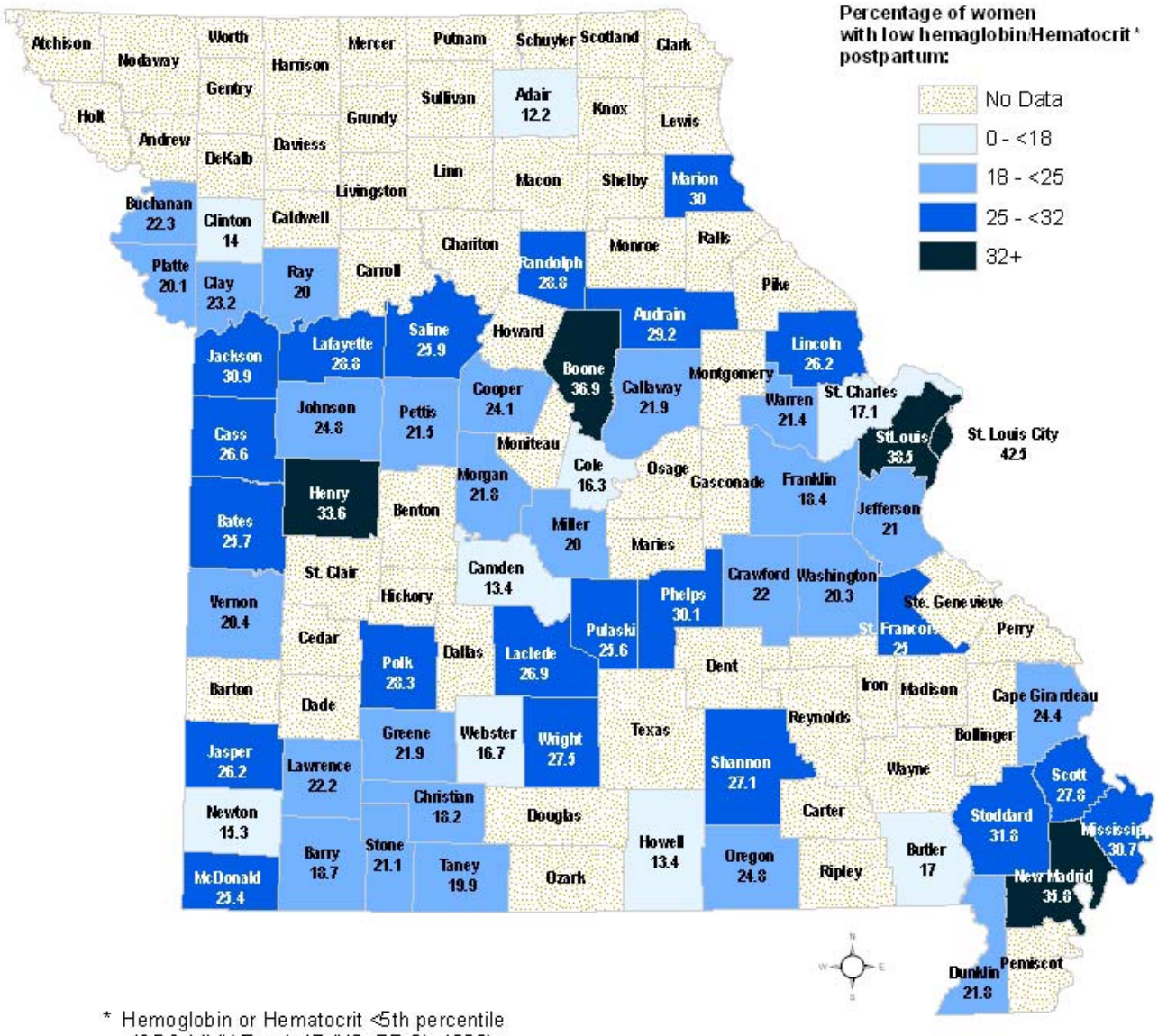


* Hemoglobin or Hematocrit <5th percentile (CDC MMWR vol. 47 (NO. RR-3), 1998)

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

Division of Community and Public Health
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kalugina, Research Analyst II
08/30/2005

Prevalence of Low Hemoglobin/Hematocrit* Postpartum, by County (Missouri PNSS 2001-2003 Combined Years)

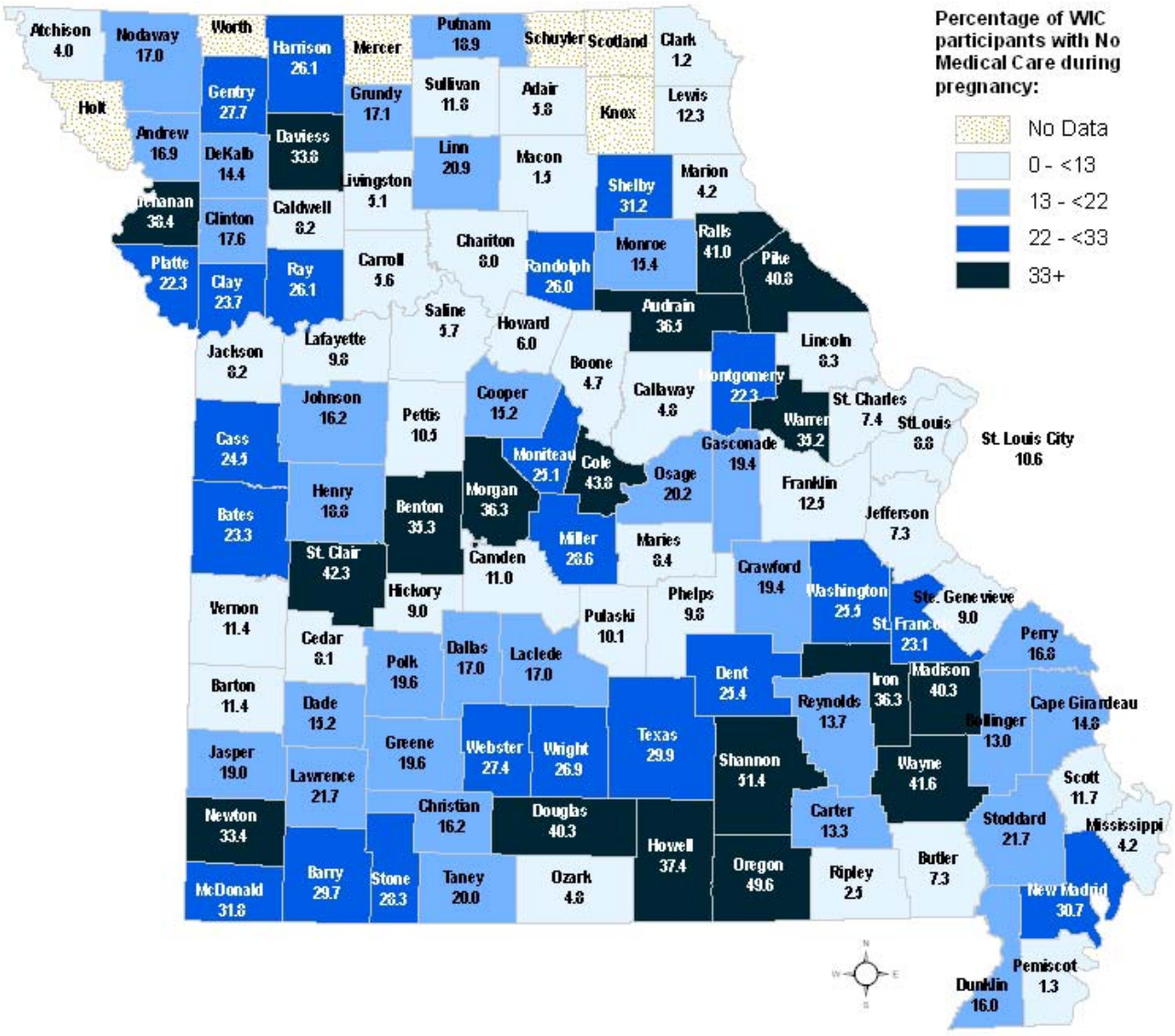


* Hemoglobin or Hematocrit <5th percentile (CDC MMWR vol. 47 (NO. RR-3), 1998)

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

Division of Community and Public Health
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kaluzna, Research Analyst II
08/30/2005

Percentage of WIC Participants with No Medical Care During the Pregnancy, by County (Missouri PNSS 2001-2003 Combined Years)



Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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Surveillance and Epidemiology
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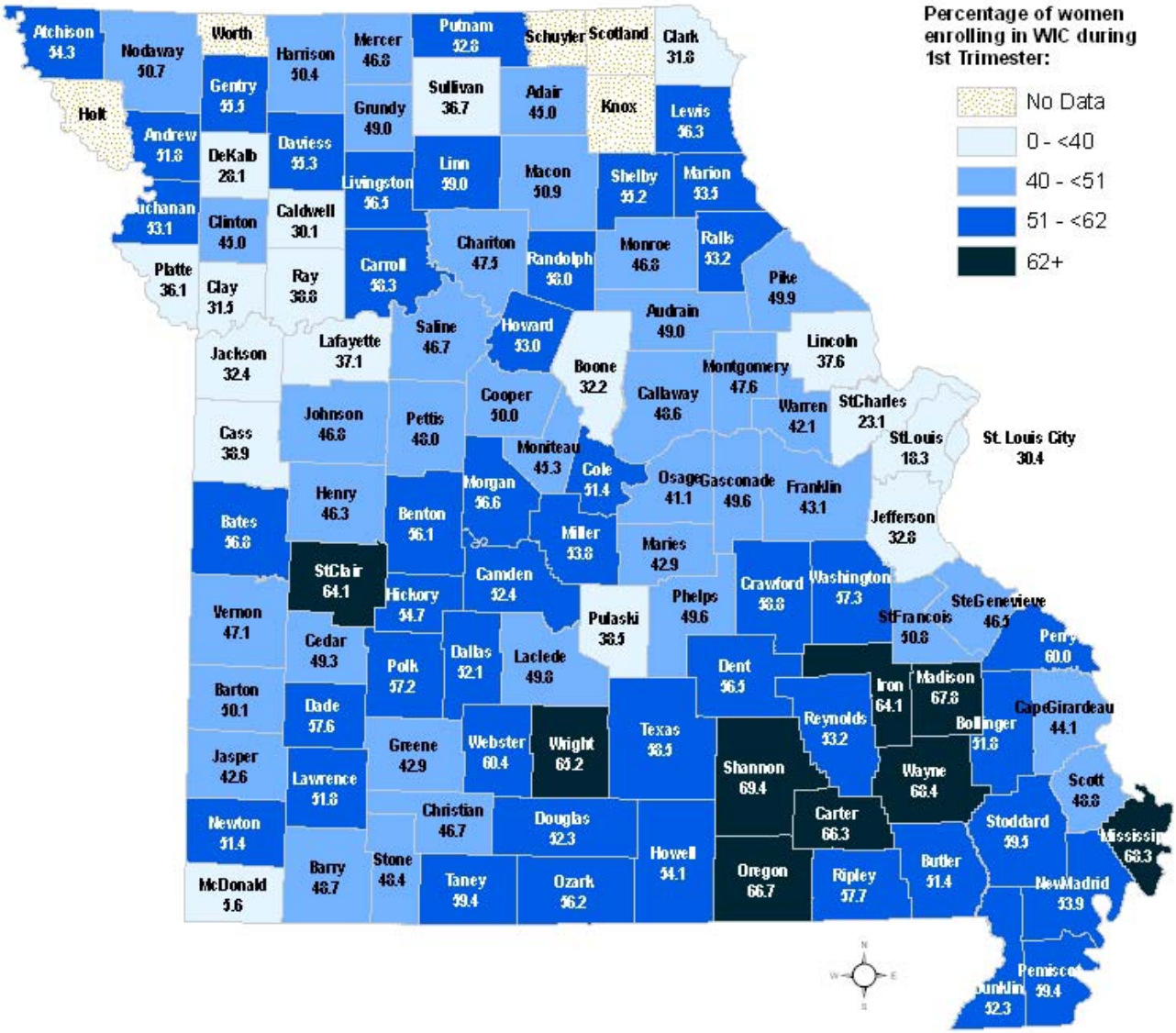
08/30/2005

Percentage of Women Enrolling in WIC During 1st Trimester of Pregnancy, by County (Missouri PNSS 2001-2003 Combined Years)



Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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Surveillance and Epidemiology
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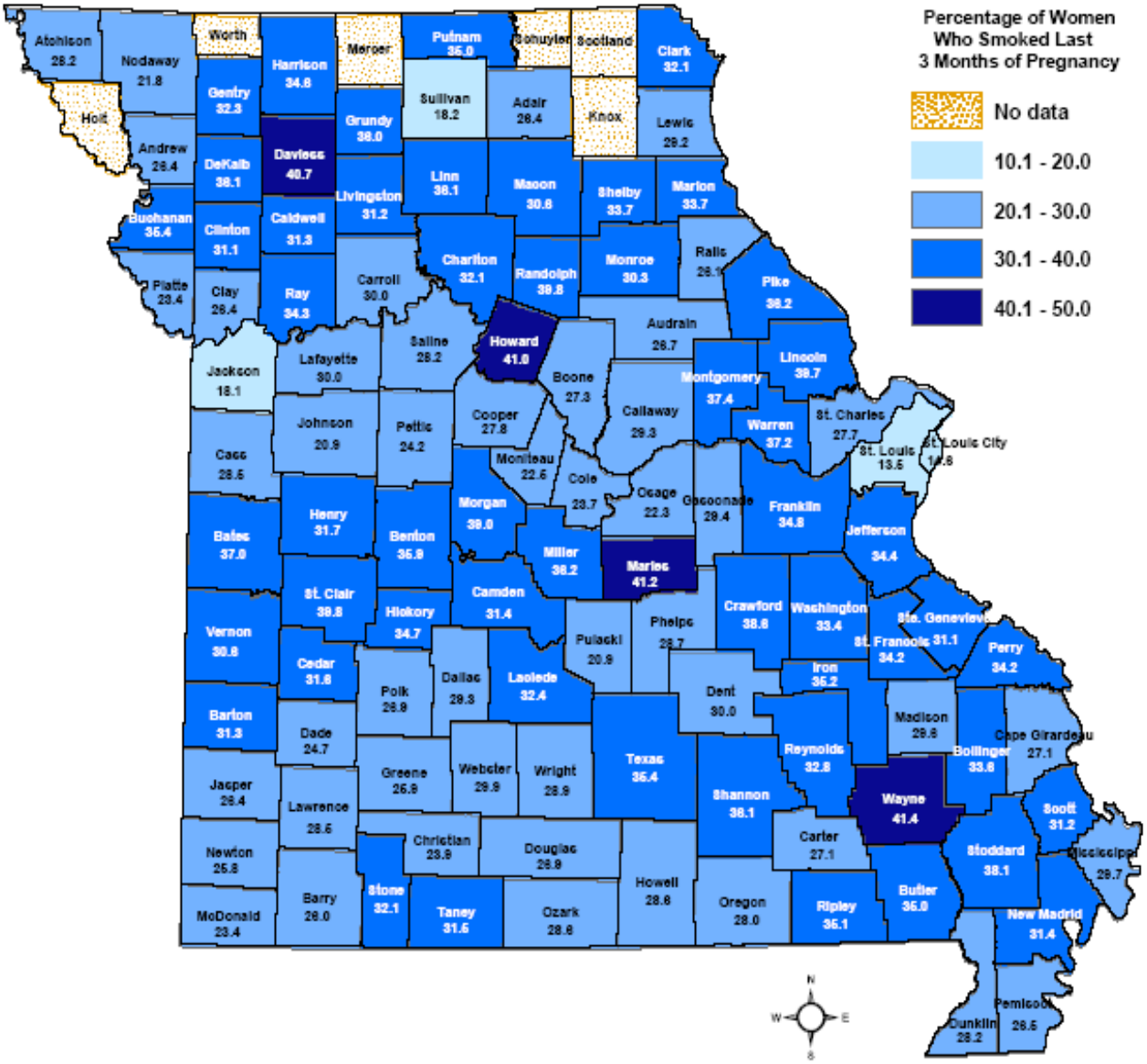
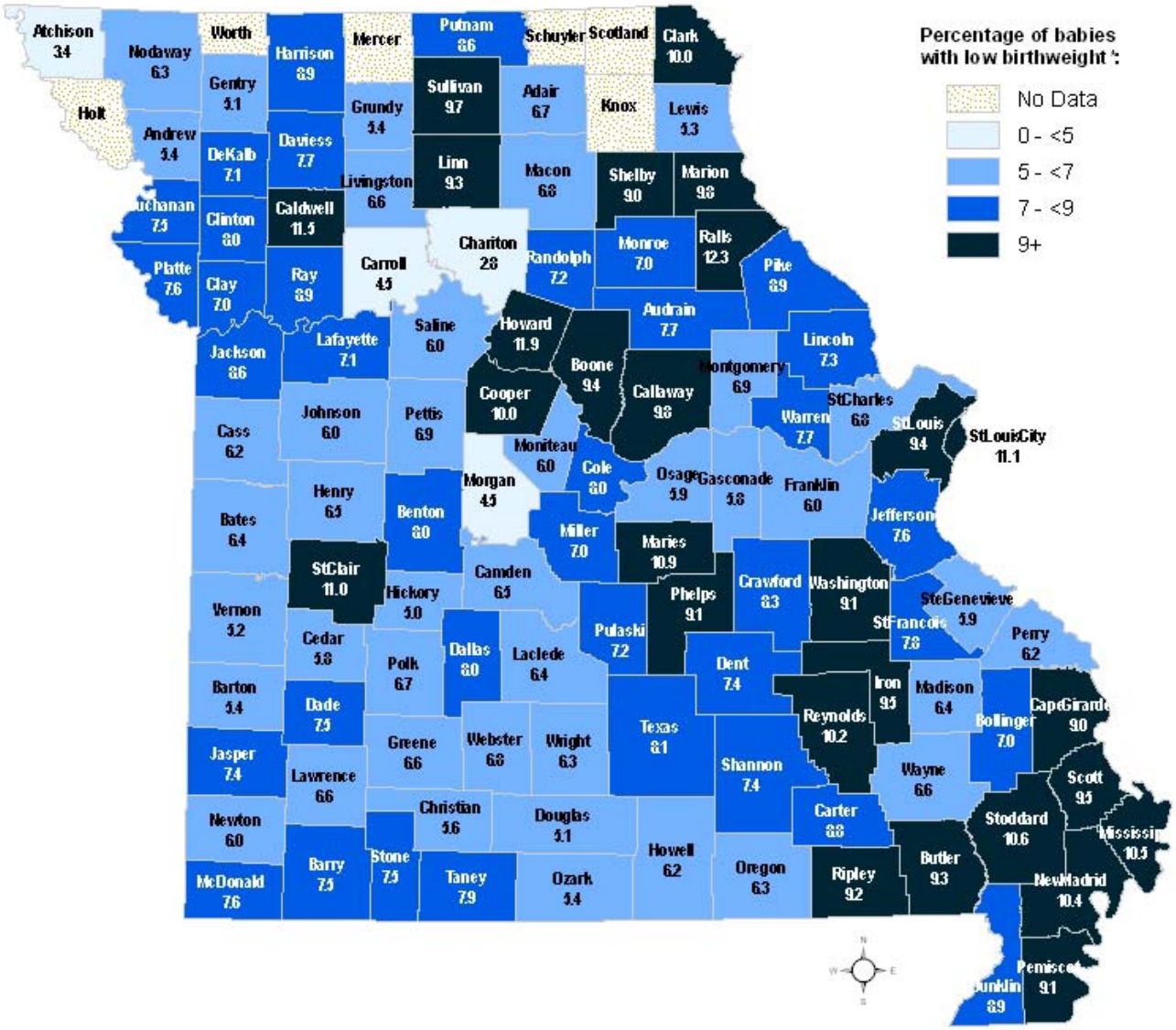
08/30/2005

Percentage of Women Who Smoked Last 3 Months of Pregnancy by County (Missouri PNSS 2001-2003 Combined Years)



Prevalence of Low Birthweight*, by County (Missouri PNSS 2001-2003 Combined Years)

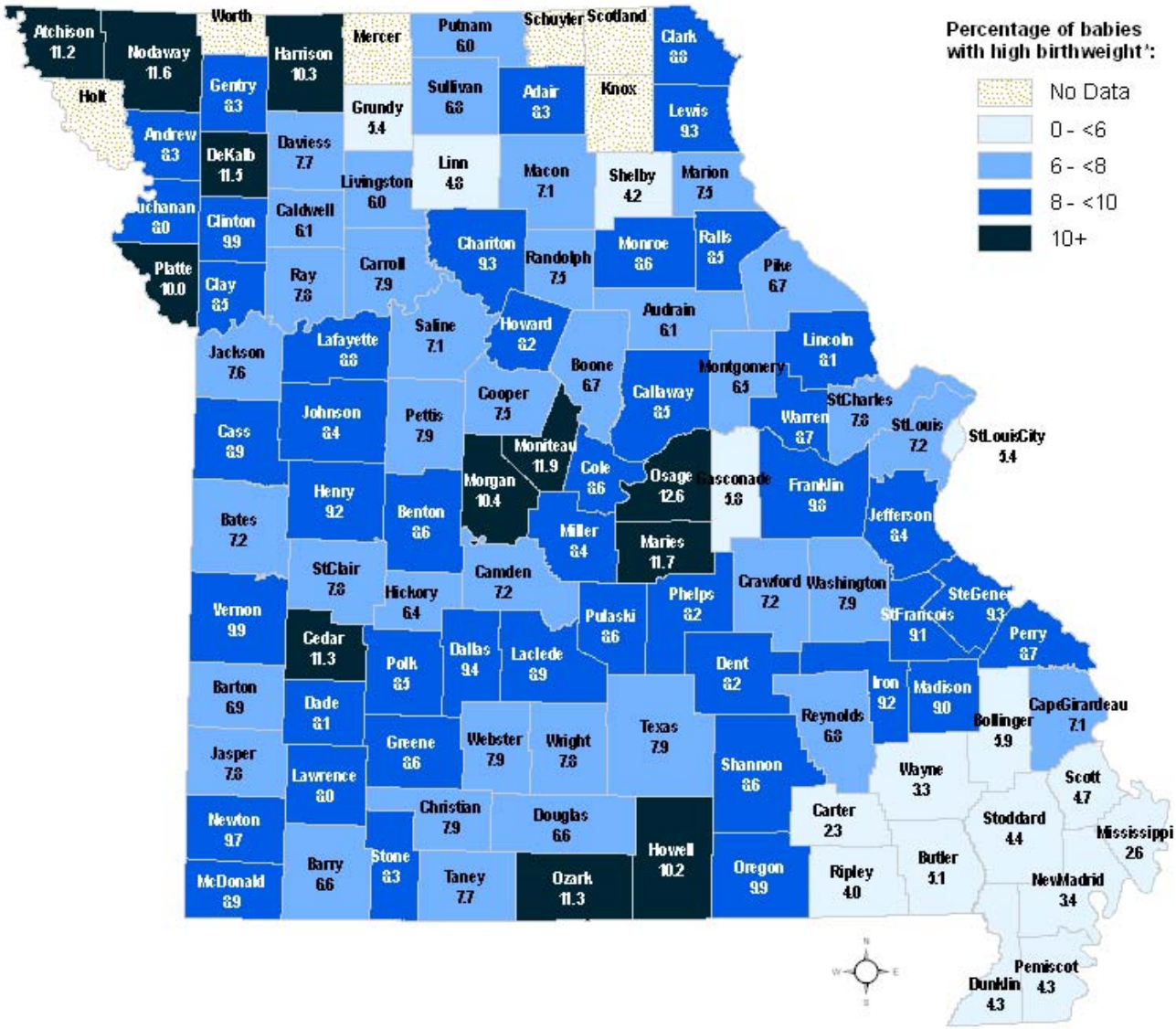


* < 2,500 grams

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

Division of Community and Public Health
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kalugina, Research Analyst II
08/30/2005

Prevalence of High Birthweight*, by County (Missouri PNSS 2001-2003 Combined Years)



* > 4,000 grams

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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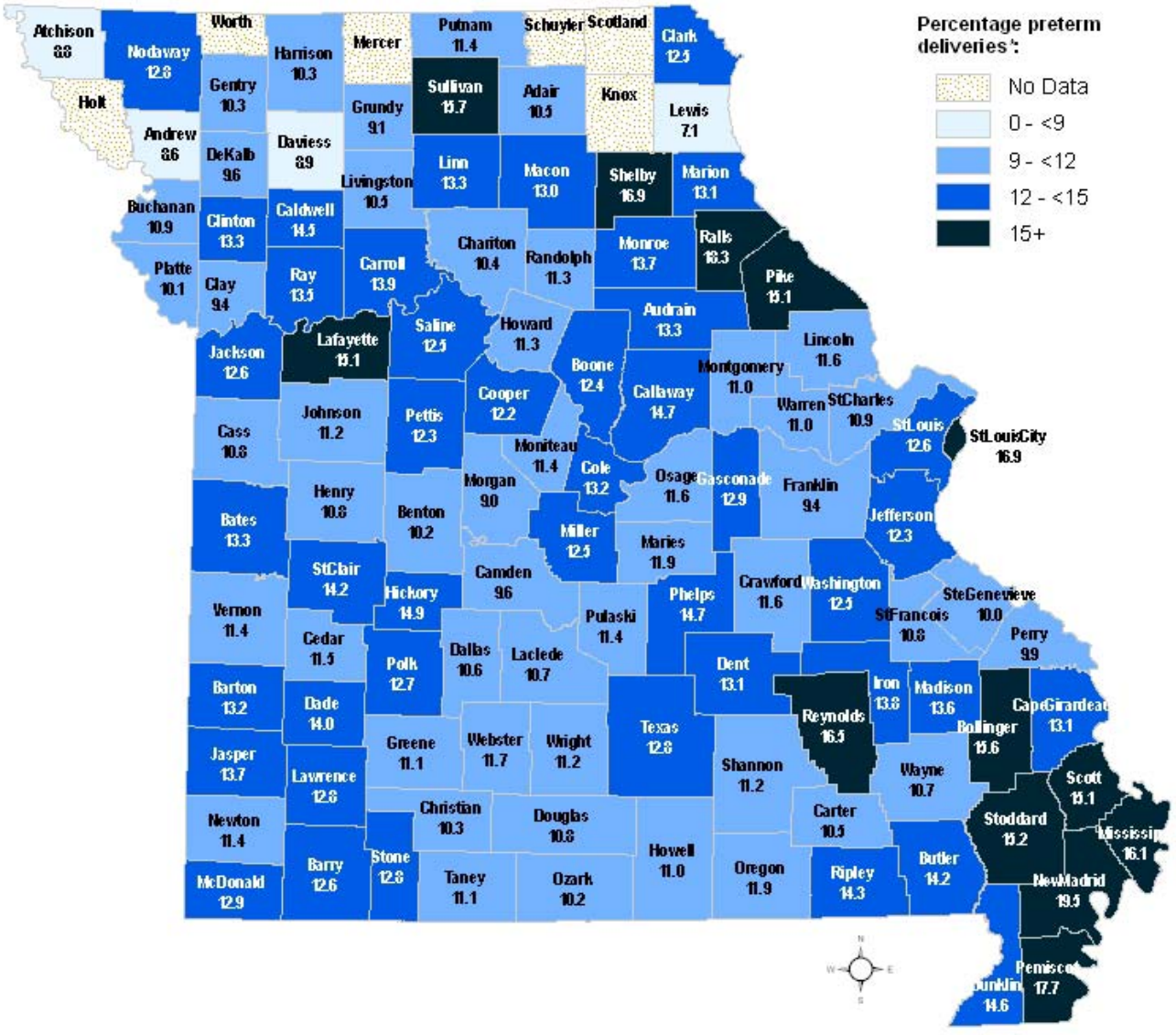
Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kalugina, Research Analyst II
08/30/2005

Prevalence of Preterm Delivery*, by County (Missouri PNSS 2001-2003 Combined Years)



* < 37 weeks gestation

Source: Missouri Pregnancy Nutrition Surveillance System
2001-2003 Combined Years
Missouri Department of Health and Senior Services

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Public Health Practice and Administrative Supports
Surveillance and Epidemiology
Kateryna Kaliguina, Research Analyst II
08/30/2005

REFERENCES

1. Reproductive Health of Women. Pregnancy-Related Nutrition…

2. O'Reilly-Green C, Cohen WR. Pregnancy in women aged 40 and older. Obstet Gynecol Clin North Am. 1993 Jun;20(2):313-31

3. Galloway R, Anderson MA. Prepregnancy Nutritional Status and its Impact on Birthweight. SCN News. 1994;(11):6-10

4. Institute of Medicine: Nutrition during pregnancy: weight gain and nutrient supplementation. Washington, DC: National Academy Press, 1990

5. Kramer M.S. Determinants of low birth weight: methodologic assessment and meta-analysis. Bull World Health Organ 1987

6. Little RE, Weinberg CR. Risk factors for antepartum and intrapartum stillbirth. American Journal of Epidemiology 1993; 137: 1177-89

7. Institute of Medicine. Nutrition during pregnancy: part I, weight gain, part II, nutrient supplements. Washington, DC: National Academy Press, 1990

8. Institute of Medicine. Nutrition during pregnancy: weight gain and nutrient supplementation. Washington, DC: National Academy Press, 1990

9. Scholl TO, Hediger ML, Schall JI, Ances IG, Smith WK. Gestational weight gain, prepregnancy outcome, and postpartum weight retention. Obstetrics and Gynecology, 1995; 86: 423-7

10. Kleinman JC Maternal weight gain during pregnancy: determinants and consequences. Hyattsville, Maryland: US Department of Health and Human Services, Public Health Service, NCHS, 1990. (Working paper; series no. 33)

11. Taffel S. Maternal Weight gain and the outcome of pregnancy: United States, 1980. Washington, DC: US Department of Health and Human Services, Public Health Services, NCHS, 1986. (Vital and health statistics; series 21, no. 44, DHHS publication no. (PHS)86-1922.)

12. CDC. CDC criteria for anemia in children and child-bearing-aged women. MMWR 1989; 38:400-4

13. Conrad ME. Iron deficiency anemia. http://www.emedicine.com/med/topic1188.htm

14. Cogswell ME, Weisberg P, Spong C. Cigarette smoking, alcohol use and adverse pregnancy outcomes: implications for micronutrient supplementation. Journal Nutrition 2003; 133:1722S-1731S

15. Ross EM. Iron deficiency anemia: risk, symptoms and treatment. Nutrition in Clinical Care Vol.5:Sept/Oct, 2002

16. CDC. Recommendations to prevent and control iron deficiency in the United States. Morbidity and Mortality Weekly Report. Atlanta, GA: US Dept of Health and Human Services. 1998;47:1-29

17. Scholl TO, Reilly T. Anemia, Iron and Pregnancy Outcome. Journal Nutrition 2000; 130: 443S-447S

18. www.cdc.gov/pednss/what_is/pnss_health_indicators.htm

19. Alexander GR, Kortenbrot CC. The role of prenatal care in preventing low birth weight. Future Child, 1995 Spring; 5(1): 103-20

20. Ahluvalia IB, Hogan VK, Grummer-Strawn L, Colville WR, Peterson A. The effect of WIC participation on small-for-gestational-age births: Michigan, 1992. American Journal of Public Health. 1998 Sep; 88(9): 1374-7

21. Devaney B, Bilheimer L, Schore J. Medicaid costs and birth outcomes: the effects of prenatal WIC participation and the use of prenatal care. Journal of Policy Anal Manage. 1992 Fall; 11(4): 573-92

22. Rush D. The national WIC evaluation: evaluation of the special supplemental food program for women, infants, and children. American Journal of Clinical Nutrition 1988; 48:389-519.

23. Ventura SJ, Kimberly MA, Martin JA, et al. Birth and deaths: Unites States, 1996; preliminary data. Monthly vital statistics report; vol 46(1), supp. 2. Hyattsville, MD: National Center for Health Statistics, September 11, 1997

24. Paneth KA. The problem of low birthweight. Future Child 1995; 5(1): 19-34

25. Kramer MS. Determinants of low birthweight: methodological assessment and meta-analysis. Bull World Health Organ. 1987; 65(5): 663-737

26. MacLeod S, Kiely JL: The effects of maternal age and parity on birthweight: a population-based study in New York City. Int J Gynaecol Obstet. 1988 Feb; 26(1): 11-9

27. Paneth KA: The problem of low birthweight. *Future Child* 1995;5(1):19–34

28. Acker DB, Sachs BP, Frieman EA: Risk factors for shoulder dystocia. Obstet Gynecol 1985; 66: 762-8

29. Berkowitz GS, Papiernik E. Epidemiology of preterm birth. Epidemiologic Reviews 15(2), 414-443 1993;15: 414-43.

30. Institute of Medicine: Nutrition during pregnancy: weight gain and nutrient supplementation. Washington, DC: National Academy press, 1990

31. Alexander GR. Preterm birth: etiology, mechanisms and prevention. Prenatal and Neonatal Medicine 1998;3:3-9.

32. Kramer MS, Chalmer B, Hodnett ED, et al. Promotion of Breastfeeding Intervention Trial (PROBIT): a randomized trial in the Republic of Belarus. JAMA. 2001: 285: 413-20

33. Breastfeeding and the Use of Human Milk. Section of Breastfeeding. Pediatrics 2005k 115: 496-506

34. Dewey KG, Heinig MJ, Nommsen LA. Maternal weight-loss patterns during prolonged lactation. American Journal of Clinical Nutrition, 1993: 58: 162-6

35. Collaborative Group on Hormonal Factors in Breast Cancer. Breast cancer and breastfeeding: collaborative reanalysis of individual data from 47 epidemiological studies in 30 countries, including 50302 women with breast cancer and 96973 women without the disease. Lancet. 2002: 360: 187-95

36. Rosenblatt KA, Thomas DB. Lactation and the risk of epithelial ovarian cancer. WHO Collaborative Study of Neoplasia and Steroid contraceptives. Int J Epidemol. 1993: 22: 192-7

37. http://www.ahrq.gov/clinic/uspstf/uspsbrfd.htm